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MACHINERY.

Vol. 8. September, 1901. No. 1.

VARIABLE SPEED TRANSMITTERS.

THREE NEW DEVICES FOR THE POSITIVE TRANSMISSION OF VARIABLE SPEED.

In the transmission of power the requirements are frequently such as to make necessary a variable speed transmitter for changing the speed of the driven shaft, or follower, relative to the speed of the driver. For this purpose cones and belts have generally been made to answer the requirements, or when it was desired to transmit the power more positively, nests of gears of different diameters have been employed with suitable devices for throwing into mesh any one of several pairs of gears, to give the desired speed changes.

There are many cases, however, where it is desirable either to obtain minute gradations in the speed or to change the speed gradually without shock or jar while the mechanism is in operation. A large number of patents have been taken out on devices for accomplishing these ends. Among these are cones with shifting belts and innumerable modifications of the revolving disc with a friction roll so arranged that the roll can be located at any point on the face of the disc, and in this way change the velocity ratio of the parts. There are also many belt-driven devices designed so that the driving and driven pulleys can be expanded or contracted to give the effect of larger or smaller pulleys, as desired.

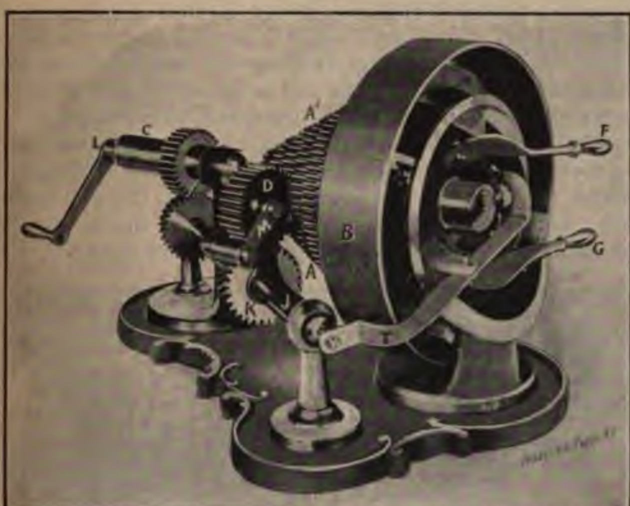


Fig. 1. Model of Shattuck Mechanism.

Until recently, however, there has been no patent issued in the United States for a positive-motion transmitter, giving small gradations in the speed and a gradual change from one speed to the next one. The numerous friction devices do not transmit the power positively, and, while nests of gears have a positive action, they do not, as ordinarily constructed, increase or decrease the speed gradually from one speed to the next. The desideratum in a variable speed device would appear to be one with a wide range in speeds, with gradual change from one speed to the next, and one that would be, withal, of good design mechanically.

The problem of *positive* variable speed transmission is not easy of solution, but it is of increasing importance, partly because of the extensive use of constant-speed electric motors, partly because of the development of the automobile industry, and for other reasons of minor importance. The descriptions which follow, therefore, of three new variable speed devices having positive action, will be of general interest. Each is an attempt to solve the problem in a different way. One is by an ingenious arrangement of gearing, whereby there is no sudden jump in the speed from one step to the next; the second is by variable-throw eccentrics on the driving shaft, which operate clutch mechanisms on the driven shaft; and the third is an arrangement of linkages to give the required speed variation. The latter is the Dieterich motion, which was first described in STEAM ENGINEERING, published by the INDUSTRIAL PRESS, publishers of MACHINERY, and while a description has since appeared in some other papers, it will doubtless be new to most of our readers.

VARIABLE SPEED WITH GEARING.

The problem of making changes in gearing ratios for varying speeds in power transmission, without interruption of the power or shock to the gears, has been rendered feasible by the Shattuck variable gearing. A general view of a model of the Shattuck gearing is shown in Fig. 1, and Figs. 2 and 3 show the details of the device, as well as the method of shifting the gears.

The principle involved in this device is to move a transmitting pinion along the face of a nest or cone of gears arranged in steps and to mesh with anyone of them while the machine is in motion; and, further, to do it without shock or sudden change of speed. The cone, or step, gear is divided longitudinally in the two parts, *A* and *A'*, one half, *A*, being rigidly fastened to the shaft, and the other half, *A'*, being arranged with the guides and slides, *E E*, Figs. 2 and 3, so as to be capable of a limited diagonal motion along its mate, *A*. The proportion of the steps of the cone of gears is so adjusted, and the direction of slant of the guides is such that when the half *A'* of the cone is shifted on the guides, as it is shown in Fig. 2, all its steps on one side will coincide with the steps of the next higher order on the other half, *A*, while the opposite edges of the halves are entirely separated.

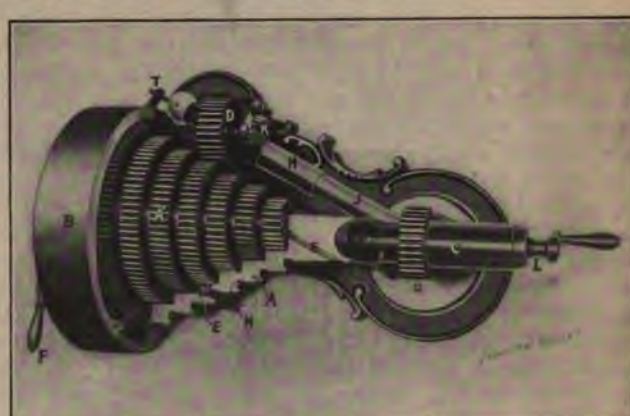


Fig. 2. Top View.

The shifting of the gear ratios is accomplished by moving the movable half, *A'*, so that the pinion *D*, which meshes with the cone, is run upon a different step than it was previously engaged with, after which the movable half is shifted back to its normal position, carrying the pinion D with it and thus keeping it engaged with the new step. The pinion *D* and the spiral gear *K*, with which it meshes, are mounted upon the feathered sleeve *H*, which rotates with and is capable of sliding along the shaft *J* so as to allow the pinion *D* to engage with any step of the cone. In order that the pinions *D* and *K* will shift along positively as the cone-half *A'* moves back to position, their frame, *M*, Fig. 1, has a tongue or shoe that fits and slides in the undercut grooves, *N*, Figs. 1 and 2, of the cone steps. This tongue and groove also serves to hold the pinion *D* automatically to the proper pitch line on any step, or when shifting. The cone-half *A'*

is shifted for changing gears by a mechanism shown at the left in Fig. 3. The cam shoe *R* attached to an extension of the movable cone-half *A'*, slides normally in the groove between the fixed plates *O* and *P;* but when it is desired to shift the cone, one of the switch points, *S* or *S'*, in the groove is shifted by the handle *F* momentarily to direct the cam shoe into a side groove, which draws the movable cone-half to its extreme travel in that direction. The cam shoe will then slide over in that side groove for one-half revolution during which the pinion is set for a change of gear, at the end of which the shoe is automatically directed back into the normal running groove, thus shifting the half-cone back to its normal position. The throwing of the handle has nothing to do but to momentarily throw the switch points in the groove, and the shifting of the gearing takes place automatically after that, so that it may be seen that it requires no skill to handle and is thus universally applicable.

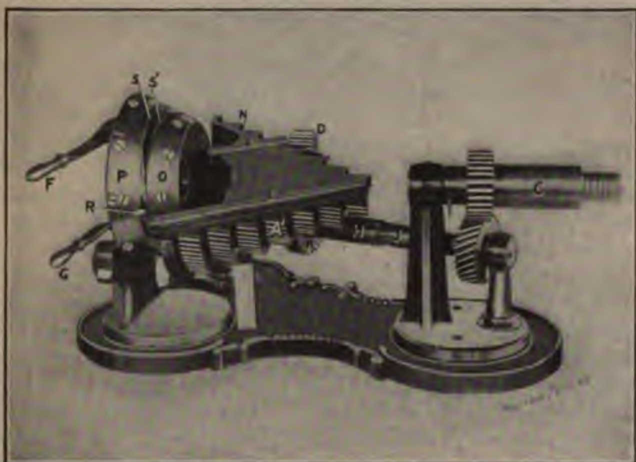


Fig. 3. View showing Model with Half the Gearing Removed.

The model is shown with a belt pulley, *B*, Figs. 1 and 2, mounted upon the gear cone shaft, and the geared transmission is delivered through the pinions *D* and *K* and the shaft *I* to the sleeve *C*, which rotates on the shaft *L*. However, this construction is not essential, and it is probable that it will be modified greatly in certain applications. The gear is not liable to injury by throwing the pinion, *D*, entirely off the gear cone, as it is provided with a safety lever attachment, *I*, Figs. 1 and 2, which prevents further shifting of the pinion than the highest and lowest steps.

The operation of shifting the pinion *D* to another step takes place as follows: The movable cone *A'* is shifted either up or down, as it is desired to transfer the pinion to a lower step or higher step, by a quick movement of the lever *F*, which deflects either point *S* or *S'*, and guides the cam shoe, attached to the movable cone half, to the left or right. This shifting of the movable half-cone directs the pinion *D* onto the lower or higher step, and then at the end of that half revolution the end of the side groove is met, which switches the cam shoe *R* back out into the normal groove, carrying the half-cone back to normal position where it remains until the speed is again changed. From this it may be seen that the change of gear ratio takes place when the movable half cone is switched back to normal position carrying the pinion *D* with it, as it is here that the pinion *D* is carried over to a different diameter of pitch circle. The change takes place gradually so that any shock or jar is impossible. If the device is to be run in only one direction, only one of the levers *F-G* need be used, but with both levers it is adaptable to motion in either direction.

This device was developed in view of its application to automobiles, but if it proves practicable in that service it will have an extensive field of application to the feeds and speeds of machine tools. It was invented by William P. Shattuck, Minneapolis, Minn., and the patents are controlled by the Shattuck Mfg. Co.

SHIFTING ECCENTRIC MECHANISM.

In Fig. 4 is an illustration of a model of a variable speed transmitting gear of the variable throw type that is now on exhibition at Buffalo. It is the invention of Edward and Frank Heymann, Boston, Mass., and is designed to give a speed variation ranging between 5½ revolutions of the driven shaft for one of the driving shaft for the fastest speed and 250 revolutions of the driving shaft to one of the driven, for the slowest speed. The direction of rotation of the driven shaft may also be changed at will so that when used as a transmitting gear for automobiles it is not necessary to reverse the motor or to use an additional reversing motion for backing.

The device has two shafts, one above the other, and the upper one of which has variable throw eccentrics that give a reciprocatory motion to clutches on the lower or driven shaft; and these clutches in turn impart a rotary motion to the driven shaft. The eccentric shaft is hollow and has three squared portions, with the sides of each at an angle of 120 degrees with the corresponding sides of the adjacent section. The eccentrics are steel discs having oblong holes which fit the squared portions of the shaft and are free to slide upon them in a direction crosswise to the axis of the shaft. The shifting of the eccentrics is accomplished by a wedge bar which slides within the hollow shaft, in connection with two keys attached to the eccentric discs, one at each end of the oblong hole. The keys pass through slots in the squared portions of the shaft in order to bear against the central wedge. These keys serve simply for shifting the eccentrics, the rotary motion being transmitted through the flats on the shaft.

There are roller bearings between the eccentrics and their straps to reduce the friction and provision is also made for taking up the wear of these bearings. The eccentric rods connect with reversible roller clutches on the lower shaft, the reversing being accomplished by means of a shaft sliding within the clutch shaft. This shaft has three positions, ahead, neutral and reverse, and when driving in one direction motion is transmitted from one shaft to the other through

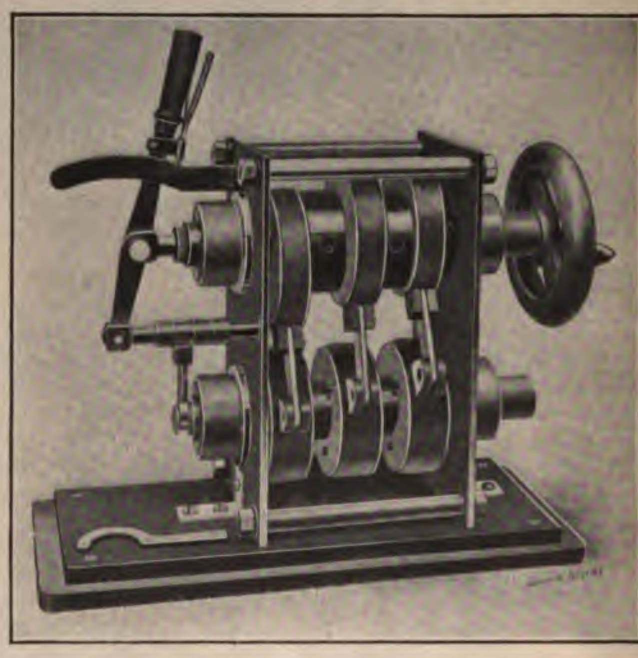


Fig. 4. Model of Heymann Mechanism.

a pull in the eccentric rods; in the reversal the clutches operate in the opposite direction and the eccentric rods exert a push upon the clutches when the latter clutch the shaft.

The wedge bar controlling the positions of the eccentrics may be operated either by a handle, as in the illustration, or by an automatic governor. Three or four eccentrics are provided according to the amount and character of work to be done. The device is mounted in an oil-tight and dust-proof case, the shafts run in roller bearings, and all parts are automatically lubricated. While it may be objected that this is not a positive variable speed device owing to the fact that dependence is placed on a roller clutch, it gives in effect a positive motion. It is possible to design a roller clutch which will grip as tight as any device which is absolutely positive from a theoretical standpoint. This device, moreover, is representative of a distinct type of variable speed devices

which should be classed with those giving in effect a positive motion.

TRANSMITTER WITH LINK MECHANISM.

What is said to have been the first positive variable speed transmitter ever patented in the United States is that invented by L. M. Dieterich, Hartford, Conn. This involves still another principle in that the variation in speed is obtained through a system of linkages, and although the element of friction enters into this device, as in the previous one, it is in effect a positive mechanism.

The idea in its simplest form is illustrated in Figs. 5 and 6. In Fig. 5 the end view shows the driving disc *A* mounted on a shaft whose end is shown in section and in side view at *G* in Fig. 6. The disc is driven in the direction indicated by

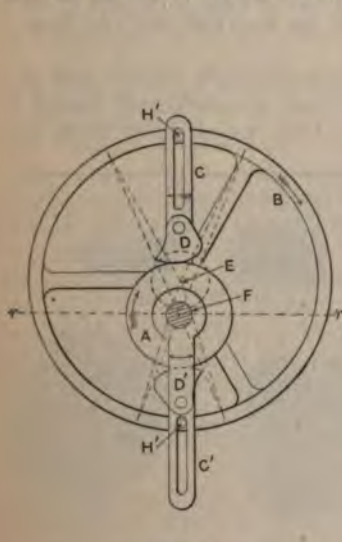


Fig. 5.

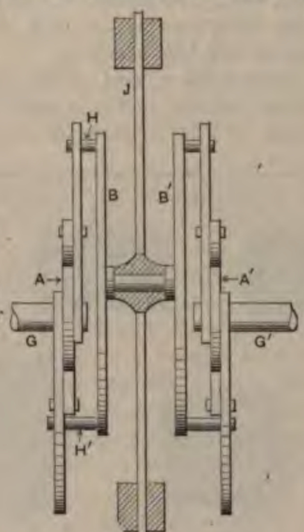


Fig. 6

the arrow and tends to drive the arms *C C'* through the cam-shaped pieces *D D'*, since these cams lock against the periphery of the disc under certain conditions to be explained. The arms *C C'* are slotted to engage the pins *H H'* set in the rim of the wheel *B*. With the center *E* of *B* coinciding with the center *F* of the disc *A*, it is evident that both cams will lock against the periphery of the disc and drive both arms

Fig. 7.

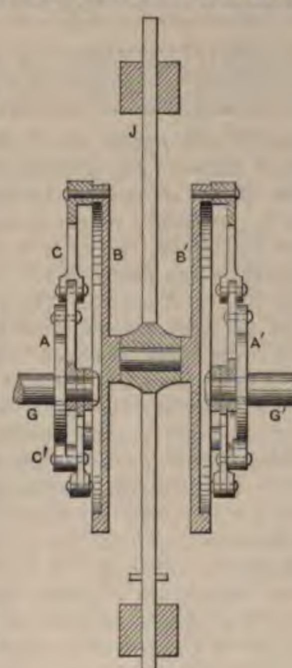


Fig. 8.

and consequently *B* at the same angular velocity as that of *A*. If, however, *B* is shifted upwards, provision being made for this as clearly shown in Fig. 6, the cam *D* will drive its arm *C*, and consequently the wheel *B*, at a faster rate than *A* turns. The consequence is that the cam *D'* does not and cannot drive since it will be carried along at a faster rate than the disc *A* and thus tends to move in an opposite direction to that needed to lock it against the disc *A*. This condition continues until the arms *C C'* have moved around one-quarter of a turn from that shown and coincide with the dotted line *r r*. Then cam *D* automatically unlocks and cam *D'* engages, since it is then beginning to travel at slower rate, and continues in engagement with the disc *A* for one-half of one turn, when the conditions are again reversed. In this manner a greater angular movement is given *B* than that of *A*, depending upon the eccentricity of the two centers *E* and *F*. As already pointed out when these centers coincide, the angular movement is the same, and it changes in proportion to the degree of eccentricity of *E* relative to *A*. It is evident that the motion transmitted to *E* is not of uniform character, the unevenness depending on the degree of eccentricity. To correct this fault, a duplicate of the mechanism just described is provided, shown at the right in Fig. 6, which is set so that its fastest periods correspond to the slowest periods of the first and thus change the character of the motion to one of uniform rate. In the first member, the disc *A* is the driver and *B* is driven; in the duplicate member, *B'* is the driver and *A'* is driven and thus transmits the motion to the shaft *G'*. The sliding piece *J* carrying the shaft of *B* and *B'* is provided for varying the degree of eccentricity. In the illustrative model just described, it is found that while the motion can be made of nearly uniform character with only two transmitting arms, it is better to use three arms. In an operative mechanism of this kind it is also evident that

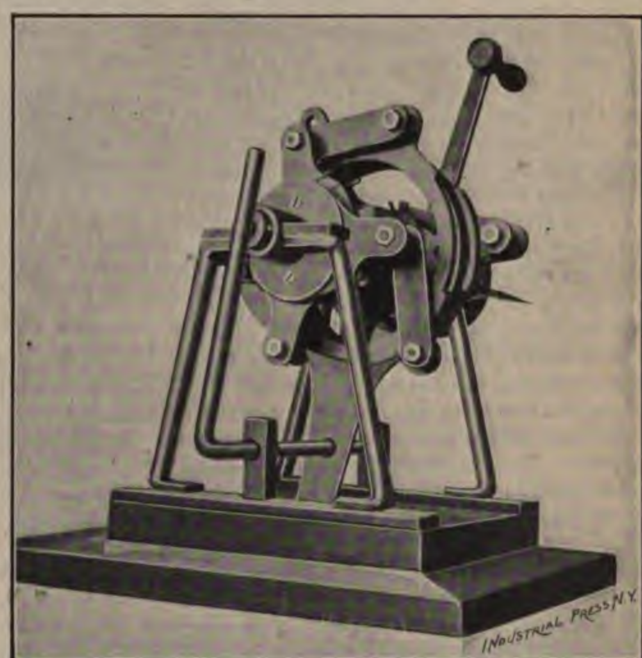


Fig. 9. Model of Dieterich Mechanism.

slotted arms working on pins or even rollers would be the source of large losses in transmission on account of the friction. The two slotted arms are, therefore, discarded for three toggle-joint arms *C C' C''*, Fig. 7, which operate in about the same manner as already described, but make uniform motion possible with a minimum of friction loss.

In the perfected device, cams like those shown in the cuts, are not used, but other devices of a nature depending somewhat on the use to which the transmitter is to be adapted.

A photograph of a model is reproduced in Fig. 9 which gives an idea of the appearance, but not of the compactness of which the device is capable. For convenience in explanation the model is so made that it combines both the straight slotted arms on one side for one member and toggle-joint arms on the other side for the second member.

When used on bicycles or automobiles the device can be made to adapt itself to the load automatically and the eccentricity of the driving and driven parts to shift so that in the case of the bicycle the rider is enabled to pedal with the same pressure whether climbing hills or riding on the level. With automobiles, while it is desirable to have the control instantly possible, it is also desirable to have a device which may be arranged to take care of the power automatically according to the nature of the roads.

CASEHARDENING.

PROCESSES THAT ARE USED-SAMPLES OF WORK BY THE AMERICAN CARBURIZING CO.

The art of casehardening metals of the iron class is one of considerable antiquity, yet it is one not very well understood or appreciated by many who would greatly profit by its use if they were well acquainted with its economic possibilities. There appears to be very little information available on the subject from any published works, presumably because it has been regarded as simple or of comparative unimportance. If the latter view has been taken, it is an erroneous one, judging from the many inquiries we have received asking for information.

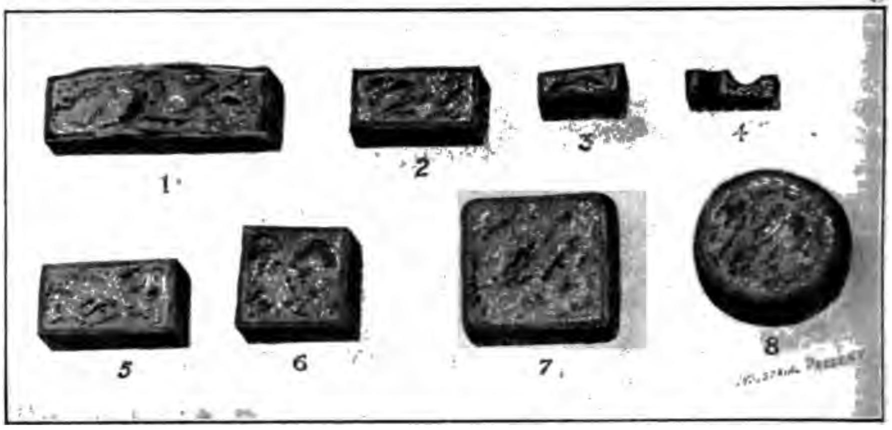
Casehardening is regarded by metallurgists as being primarily a cementation process in which carbon is added to the outer shell of metal and chemically combined with it, making steel. The addition of the carbon causes the outer shell to harden when heated to a bright red and quenched in water. As is generally known, carbon is the principal constituent which makes the difference between the physical structure of wrought iron and that of cast iron and steel. Wrought iron contains little or no carbon. Cast iron contains carbon, but in a segregated or uncombined form. Steel contains carbon chemically combined with the metal. Soft gray iron may contain as much as 3.5 per cent. of uncombined graphitic carbon and from 0.12 to 0.30 per cent (12-100 to 30-100 of 1 per cent) chemically combined. Cast iron having 2 per cent of uncombined carbon and 1½ per cent of combined carbon is known as white cast iron and is so hard as to be unworkable with ordinary tools. Steel may have percentages of carbon ranging from, say, 0.05 per cent for basic Bessemer steel to 1½ per cent for the high-grade crucible steel used in razors. The first quality of steel cannot be hardened by simply heating and dipping, but the addition of sufficient carbon to raise it to, say, 0.70 per cent will enable it to be hardened sufficiently for many purposes. This is what the casehardening process does for malleable iron, wrought iron and low-carbon steel. It adds sufficient carbon to the outer shell to cause it to harden when quenched in cold water. The thickness of the shell depends on the size of the pieces and the time given to the cementation or acieration process. Nitrogen also plays an important part in the process and is always present in all casehardening compounds, usually in the form of ammonia (NH_3).

For superficial casehardening where a thickness of hard shell of only about 1-100 inch is required, potassium cyanide (CNK) also called cyanide of potassium or cyanide of potash, is used. The articles to be hardened may be heated in an open fire to a bright red and then coated with the cyanide, the workman being careful to avoid breathing the poisonous fumes. After the piece is well smeared with the cyanide, it is again heated and then quenched in clear cold water. A better method of using the cyanide, is to heat it in a wrought iron pot to a red and keep it at this temperature. The articles should be immersed from three to five minutes, depending on the size and depth of casehardening wanted. Remove and plunge in water if the bath is at the proper temperature for hardening. If not, reheat and then plunge.

Potassium ferrocyanide ($K_4Fe''Cy_6$) is also used in about the same manner. It is commonly called prussiate of potassium or yellow prussiate of potash. Cast iron may be casehardened by heating and covering it with a composition of equal parts of yellow prussiate of potash, sal-ammoniac and saltpeter, all pulverized and thoroughly mixed together. When the article has been well covered with the compound, dip into a solution of 2 ounces of prussiate of potash and 4 ounces of sal-ammoniac to one gallon of water. Probably equally as good results will be obtained by dipping in clear water as far as hardening goes. The solution may tend to prevent cracking and warping, which is quite likely to occur with cast iron.

The above methods of casehardening give superficial results only and are only employed on small articles which quickly heat and which only require a surface hardness. When considerable depth of hardening is required, especially on large pieces, it is necessary to pack them in a box surrounded by some carburizing material and to heat the box in a furnace for a period ranging from three to thirty hours, depending on the material used and the size of the pieces. A great variety of carburizing substances are used, mostly of animal origin, such as bone dust, charred leather, animal charcoal, hoof parings, horn, ammoniated compounds, soot, etc. The choice of compound should of course be made with reference to the cost of the material and the time required for the process.

Before the advent of the Bessemer steel process, iron rails were used on railways with most unsatisfactory results because of the softness of the iron, which made them wear



SAMPLES OF WORK CASEHARDENED BY THE AMERICAN CARBURIZING COMPANY.

1. Time, ten hours; casehardening, 1-8 in. deep; size, 8 in. long, 2 in. wide and 5-8 in thick.
2. Time, six hours; depth of casehardening, 1-16 in.; size, 8 in. long, 1 1-4 in. wide and 5-8 in. thick.
3. Section of friction ring, 4 in. diameter, 3-4 in. wide and 5-16 in. thick. Time, ten hours: depth of casehardening, 1-16 in. Large quantity done in cast iron pot 24 in. diameter and 20 in. high; bright orange heat.
4. Ball race 2 in. diameter, 7-8 wide and 1-4 in. thick. Time, three hours; depth of casehardening, 1-32 in.; orange heat.
5. Time, eight hours; depth of casehardening, 3-32 in.; size same as No. 2.
6. Time, nine hours; depth of casehardening, 3-32 in.; size, 8 in. long by 1 in. square; material, wrought iron.
7. Time, twelve hours; depth of casehardening, 1 8 in.; size, 8 in. long by 1 5-16 square.
8. Time, eight hours; depth of casehardening, 1-16 in.; size, 1 1-4 in diameter.

Samples 1, 2, 3, 4, 5, 7 and 8 were machinery steel of .12 to .14 carbon. Samples 1, 2, 5, 6, 7 and 8 all packed in boxes 10 in. x 12 in. x 4 in.; walls, 1-2 in. thick. Boxes cooled down, pieces reheated in open fire and quenched. Furnace heat, bright orange.

rapidly and pound out of shape. Some of the English railways followed the practice of casehardening their iron rails, the depth of the casehardening ranging up to one-fourth inch. In Dodd's patent furnace, which was specially designed for this work, the rails were packed in charcoal, lime, and potash in the proportion of 9 parts of charcoal to one each of the lime and potash. The carbonization varied from 0.25 to 0.86 per cent carbon, depending on the time allowed. When the rails were removed from the furnace, they were covered with sand and allowed to cool slowly. It would appear from this that the rails were sufficiently hardened by the carbonization process, without dipping, the exterior portion being similar to the ordinary steel rails now used.

An excellent casehardening has been obtained by treating the articles with a mixture of rasped leather or horn with arsenious acid dissolved in hydrochloric acid. Another casehardening compound is made from albumin ($C_{72}H_{112}N_{18}SO_{22}$) and magnesium sulphate ($MgSO_4 + 7H_2O$) in the proportion of 100 pounds of albumin to 15 pounds of the magnesium sulphate. The ingredients require to be well dried and pulverized and thoroughly mixed together. It is used in a muffle and requires from 12 to 48 hours' heat in a furnace. Azotized animal matter, that is, horns, hoofs, bones, hair, etc., treated with nitric acid and mixed with potassium carbonate (CO_3K_2) gives off abundant quantities of potassium ferrocyanide when heated in a furnace. Consequently articles packed in such a compound would absorb carbon and nitrogen and harden when dipped. The Krupp and Harvey armor plate hardening process is essentially one of casehardening carried to considerable depth.

There are other compounds on the market for casehardening which have been developed by long and careful experimenting, and which give superior results than bone dust and similar substances when the cost and time are considered. It has been demonstrated that a compound of certain case-hardening materials in certain proportions may be much more effective than the same ingredients in other proportions. Just why this is true is not well understood. The chemical action which takes place in casehardening is probably not as simple as has been assumed. One of the well-known compounds of this nature is that manufactured by the American Carburizing Company, Jersey City, N. J. In the course of the experiments made by Mr. Engler it was demonstrated that a slight variation in the proportions would make a decided change in the efficiency of the material and time required. It weighs about two-thirds as much as bone dust and requires one-third to one-half the time in the furnace. The accompanying photographs give the appearance of the fractured ends of pieces of different material and the time required to caseharden.

The pieces to be casehardened are packed in cast iron boxes of a size suitable to the pieces. For small work to be done in large quantities, 12 x 24 x 12 inches is a convenient size. Where small pieces are to be done a few at a time, the boxes should be as small as will accommodate them with a thickness of carburizer around them about one-half inch thick. The boxes should be made of a quality of cast iron which resists heat well, such as a good quality of stove plate. They are cast open at the top and should have a wall thickness of ½ to ¾ inch. When a box is charged, it is filled full of the articles to be hardened, carefully packed with the carburizing material so that no two pieces shall touch and so that no pieces shall come nearer the sides of the box than about one-half inch. Of course, with small articles, they may be placed closer than this distance if great care is taken that none actually touch the sides. If any articles touch one another or the sides of the box, they will not be carburized at the point of contact and are quite likely to fuse fast and be spoiled.

The open top is covered with pieces of sheet metal, say ⅛ inch thick, cut so as to nicely fill the opening, and then the edges are luted with fire-clay to make the box as nearly air-tight as possible. They may be heated economically in a coal or coke furnace where large quantities of work are being done. There are furnaces on the market specially designed for this class of work. There are also gas furnaces which are well adapted to this class of work, especially where small quantities are being done at a time. The gas furnaces heat quickly and require very little attendance, which more than offsets the extra fuel cost over the coke or coal furnace.

The boxes should be kept at a uniform temperature as nearly as possible during the time they remain in the furnace. The temperature recommended is that commonly known as orange or somewhat higher, if the cast-iron boxes will stand the heat. There is little or no danger of harming steel pieces while packed in carburizing material, since they are protected from the atmosphere and gain carbon instead of losing it, as is the case in an open fire. When the boxes have been in the furnace such a time as experience has demonstrated to be proper, they are hauled out carefully, since cast iron is quite fragile at high temperatures, and the whole contents dumped into a receptacle containing water. It is the usual practice to have a wire screen suspended in the water and counterbalanced so that the articles may be raised to the furface when cooled without "fishing" for them at the bottom. Another method recommended by the American Carburizing Company and which has been found preferable in many cases, is to pull out the boxes and store them where they will cool down slowly. Then, when entirely cold, the pieces are removed and reheated in an open fire to the proper temperature (cherry for small pieces and a bright cherry for large pieces) and then dipped in clear cold water.

Sometimes it is desirable to caseharden a portion of a piece and leave part of it soft. This may be accomplished in a number of ways. The pieces may be packed in the usual manner and the portions to be soft covered with cast iron turnings, clay, sand or any refractory material which will exclude the fumes of the carburizer from the metal. Another method which is quite successful in the case of finished articles, is to thinly electroplate the piece with copper, polish off the parts to be hardened and then caseharden in the usual manner. The copper plated portions will be unaffected and soft while the remainder will be casehardened. Another plan is to turn and finish a piece to size where it is to be hard and leave the portions to be soft, considerably larger than the finish size. After the piece has been carbonized, it is allowed to cool slowly the same as in annealing. The oversize parts are then turned to size and the piece heated and quenched. That part which was turned will be soft because the carbonized metal has been removed. This scheme is employed in fitting such machine parts as locomotive pins which require a hard working surface but which should be soft in the taper parts fitted in the rocker and in the thread at the end.

The practical advantage of casehardening is that pieces requiring a hard exterior may have a soft and tough interior and be less likely to breakage. In the case of bicycle cups and cones it has been found by experience that low-carbon steel when casehardened is better material than crucible steel. The working surfaces may be left glass-hard while the interior will be tough and unlikely to break. When made from high-carbon steel it is necessary to draw the temper after hardening in order to prevent breakage, consequently the working surface is softer than with casehardening. Again a cheaper material may be used which is a decided advantage, especially on large parts. Wrought iron is much easier machined than high-carbon steel, and is cheaper. The working surfaces may be casehardened and answer all practical requirements. The links used on the valve motion of locomotives are well-known examples of casehardened wrought iron construction.

Another feature about casehardening is that low-carbon steel may be successfully employed in the manufacture of metal-cutting tools. The Schenectady Locomotive Works make many large milling cutters from machinery steel, and caseharden the teeth. The cutters are considerably cheaper in first cost than if made from crucible steel, they are said to be less likely to be broken in the hardening process and stand the work fully as well.

* * *

WORK ACCOMPLISHED UPON A HORIZONTAL BORING MACHINE.

The Detrick & Harvey Machine Co., Baltimore, Md., have sent us several photographs, reproduced on P. 6, of their universal horizontal drilling, boring and milling machine operating upon the frame of a traction engine. These illustrations are of interest in showing to what an extent it is possible to increase the range of a standard machine by a study of the conditions to be met. The machine proper is simply a horizontal floor boring machine in which the boring bar is carried by a saddle capable of sliding up or down on a vertical column. Provision is made for an outer support for the bar when the character of the work requires it. In these respects it is similar to any well designed boring machine.

Its universal feature comes from the adoption of a tilting and swiveling table, and the addition of feed mechanism to the saddle and column so that a milling cutter may be used on the end of the boring bar. The fact that the table both swivels and tilts makes it possible to adjust it to any angle with the base plate between 90 and 180 degrees.

The traction engine frame illustrated required nine operations, including boring, milling and drilling. Part of the faces to be finished were at an angle with the center line of the engine, and the casting was completed without changing its setting, all movements being made in the machine itself.

The operation of boring as shown in Fig. 1 is done with an ordinary boring bar, furnished with a head carrying several tools. The outer end of the bar is carried on a bearing on the base plate, to secure greater rigidity. Two cuts are taken at this chucking, the latter with a coarse feed.

With the work in the same position, the seat for the cylinder is faced and the holes for securing the same are drilled. The top of the table is then rotated one quarter of a revolu-

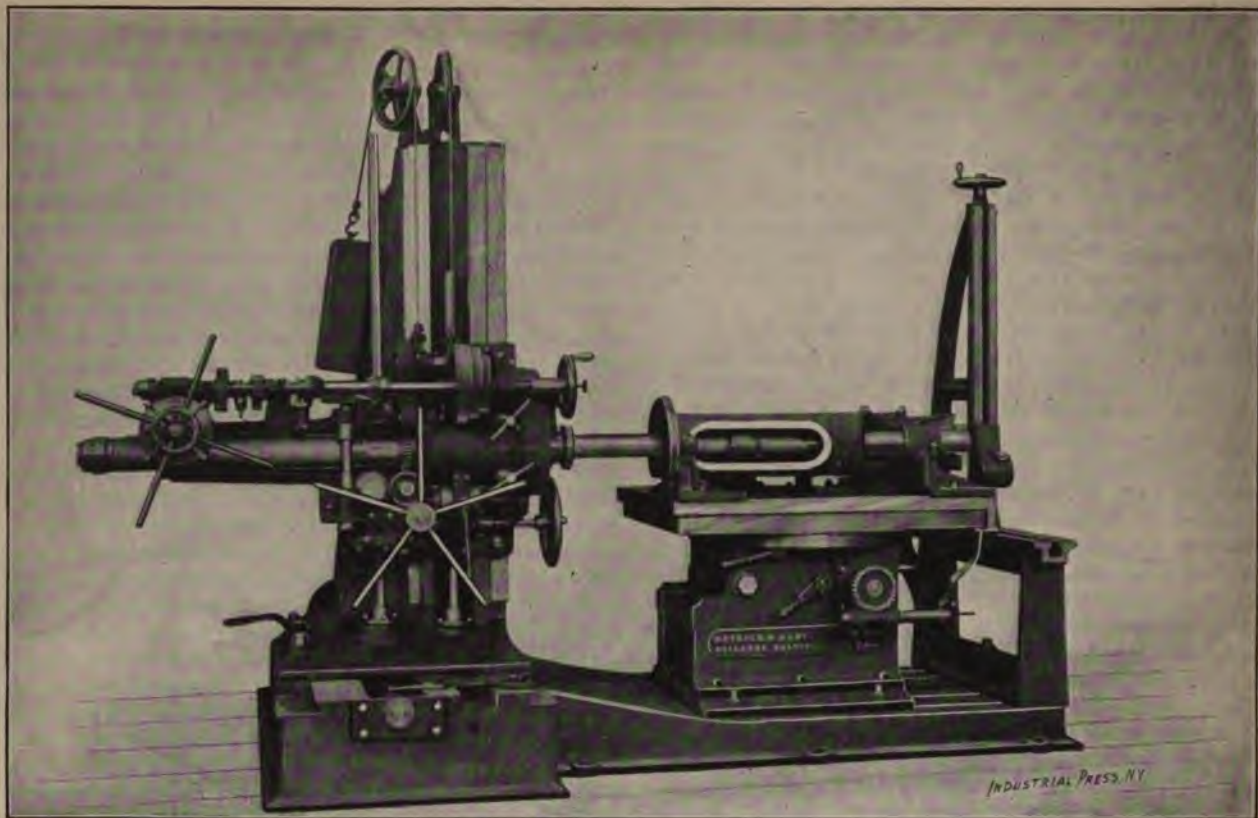
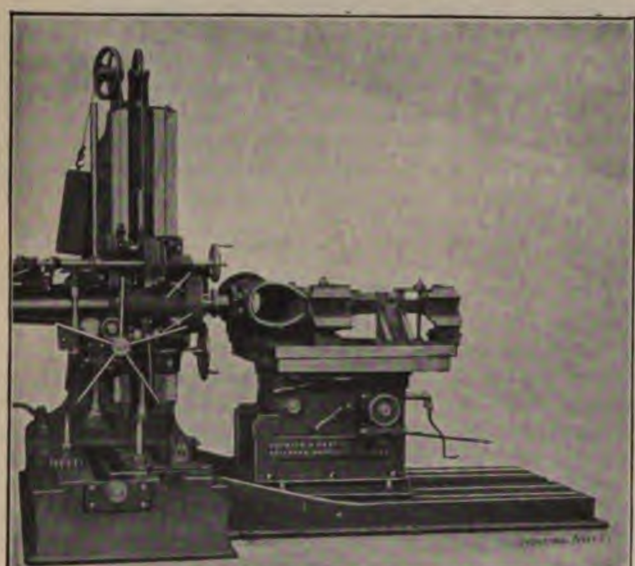
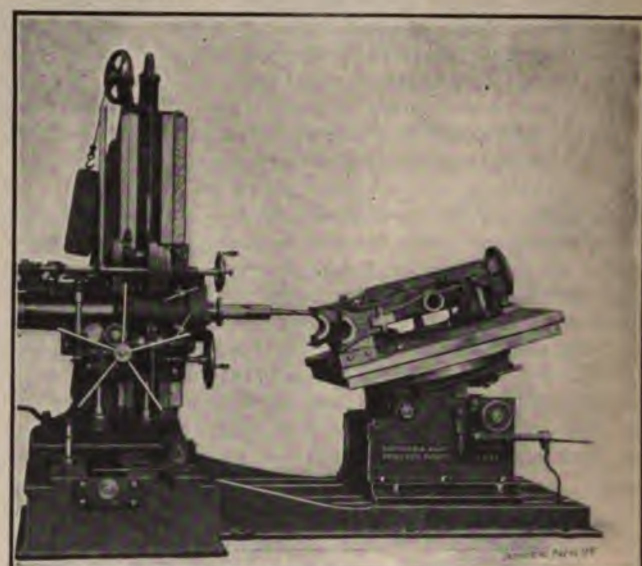
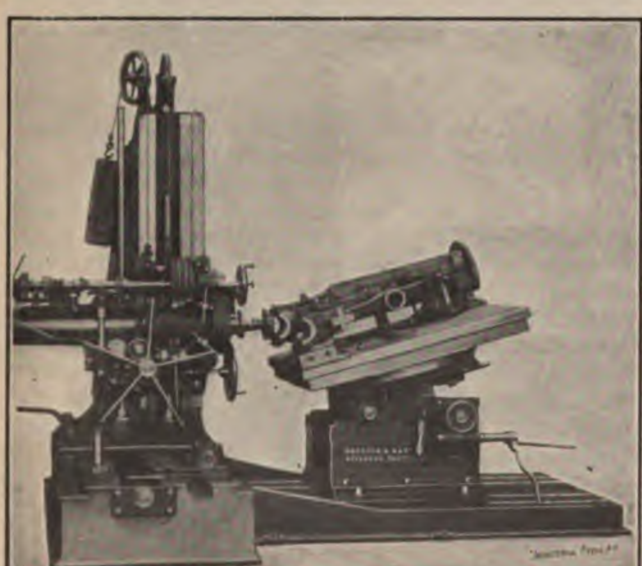
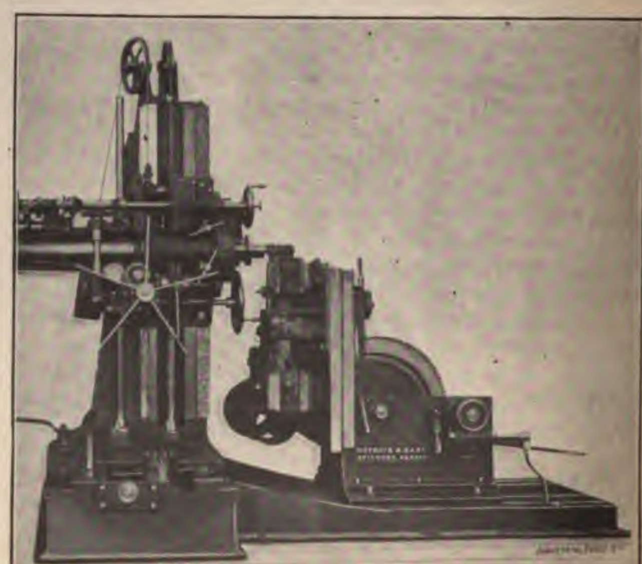


Fig. 1. Horizontal Boring, Drilling and Milling Machine.









Figs. 2 and 3. Figs. 4 and 5.

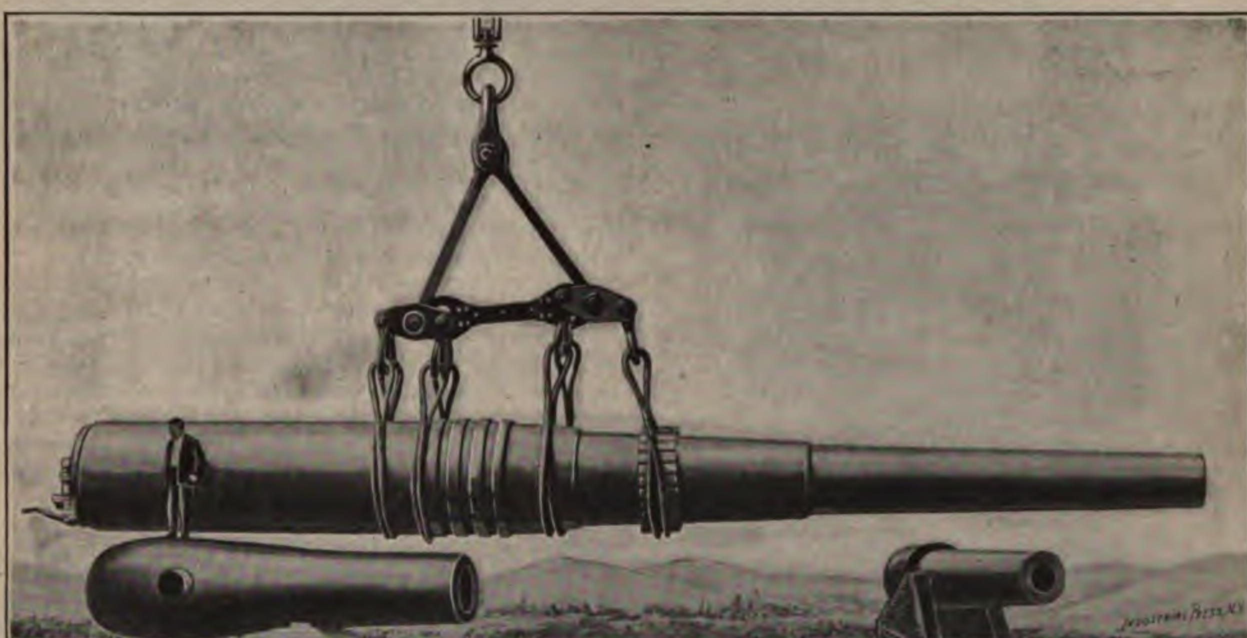
MACHINING THE FRAME OF A TRACTION ENGINE.

tion, the work being in the position shown in Fig. 2. The side, top and bottom edges of the frame opening are milled, the milling being done with an inserted tooth end mill, and a slabbing mill.

The top of the table is again rotated one-quarter of a revolution and tilted to the proper angle, as shown in Fig. 3. The seats for the crank caps are milled with an inserted end mill, after which the stud holes are drilled and tapped in the same position, as shown in Fig. 4.

The top of the table is then rotated back one-quarter of a revolution and tilted into an upright position, as shown in Fig. 5. Here the seats for attaching the frame of the boiler are milled with a gang of mills, and the holes drilled for the bolts, this operation not being shown.

The top of the table is then thrown back into a horizontal position, and the faces of the bearings for crankshaft are finished with a bar and facing heads—the outer end of the bar being carried in the outer support bearing, shown in Fig. 1. The work complete required about eight hours, and was accomplished entirely without special tools or fixtures, with the exception of the plate on which the frame is chucked. One of these machines is on exhibition at Buffalo, as has previously been noted in these columns. It has a spindle 3 7-16 inches in diameter, with a traverse of 24 inches. The saddle has a vertical movement of 40 inches, and the column a horizontal traverse of 40 inches.



20-inch Rodman Smoothbore. Weight 116,000 Lbs. Projectile Round Shot 1,000 Lbs. 16-inch B. L. Rifle. Weight 358,400 Lbs. Projectile 2,370 Lbs. 300-pounder 10-inch Parrott Rifle, Weight 26,000 Lbs. Projectile, 300 Lbs.

The 16-inch Gun Compared with those of Fifty Years Ago.

THE LARGEST GUN.

ONE OF THE RECENT NOTABLE PRODUCTS OF THE MACHINE SHOP.

A report has been made by Col. J. P. Farley, Ordnance Department, U. S. A., upon the 16-inch rifle recently completed for coast defense. This report was printed in the *Journal of the U. S. Artillery*, and for the following points of interest and the photograph from which our cut is made we are indebted to the *Engineering News*, in which an abstract of the report was published.

This 16-inch rifle is a type gun, the first of a series intended for seacoast defense. While guns of larger caliber have been constructed—such as the 17.76-inch Italian gun, the 16.5-inch French gun and the 16.25-inch Armstrong gun for battleships, none of these compare in energy and range with this new 16-inch American gun. With smokeless powder this latter gun requires a charge of 576 pounds; and with a maximum powder pressure of between 37,000 and 38,000 pounds to the square inch, it is estimated that this gun will throw a 2,370-pound projectile, with a muzzle velocity of 2,300 feet per second, and a muzzle energy of 88,000 foot-tons. By using a slower burning powder, it is believed that a greater energy and velocity can be developed. In comparison with this estimate, the Italian gun imparted to a 2,000-pound projectile a muzzle velocity of 1,700 feet per second, and a muzzle energy of only 40,000 foot-tons. The French gun used a 1,700-pound projectile, with a muzzle velocity of 1,700 feet per second and a muzzle energy of 36,000 foot-tons. The English projectile weighed 1,800 pounds, and the velocity was 2,100 feet per second, and the energy 51,000 foot-tons at the muzzle. Expressed in percentages, with the American gun representing 100, the maximum energy of the Italian gun was 45 per cent, that of the French gun 41 per cent, and the English gun 65 per cent.

The projectile for the American gun will be 5 feet 4 inches long; and it would penetrate, at the muzzle, 42.3 inches of steel. The range is estimated at about 21 miles; and in making this range the shell would reach a maximum elevation of 30,516 feet, or nearly 5.8 miles.

The total length of this gun is 49 feet 2.9 inches, with a rear diameter of 60 inches, gradually diminishing to 28 inches at the muzzle. The length of the main bore is 37 feet 4.5 inches, with a diameter of 16 inches.

This 16-inch gun is built up as follows, the hoops being designated by letters according to usual custom: The tube is 566.5 inches long, with an outside diameter of 29.3 inches. Two C-hoops are shrunk over the tube from the forward end of the jacket to the muzzle. The jacket is 304.65 inches long, and is shrunk on the rear portion of the tube from the end of the C-hoop; this jacket overhangs the rear end of the tube for 24.4 inches and forms the breech recess. The D-hoop is 144.5 inches long, and is shrunk over the forward end of the jacket and rear part of the C-hoop. Its bore contains two locking shoulders, which grip over two corresponding shoulders on the jacket and C-hoop, and thus prevent the sliding backward of the jacket, or forward of the C-hoops. Three A-hoops are next shrunk on; the A^1 overlaps the rear part of the D-hoop with its front end, and the outer surface of the jacket with its rear end; hoops A^2 and A^3 are shrunk directly over the jacket. The B-hoops will be shrunk outside of the A-hoops, and their form depends on the style of mount finally adopted—a detail not yet fully determined. For the same reason the full weight of the finished gun cannot be given, though this can be estimated from some of the finished weights of parts. The total finished weights of these parts are 248,030 pounds. The probable finished weight of the gun will be 358,400 pounds. The modified estimate of 1891 calls for a completed gun weighing 130 tons, from forgings which in the rough were to weigh 375 tons.

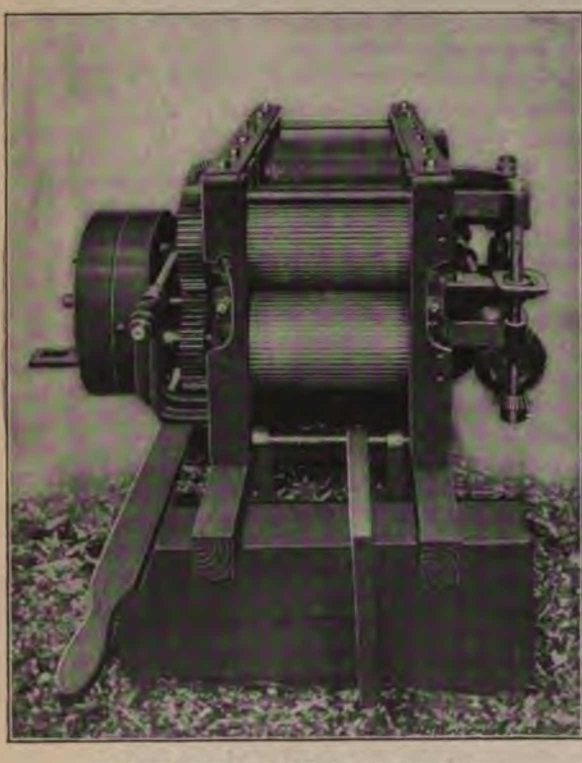
The special tools for making this gun were contracted for in 1894, and three boring and turning lathes, designed at the

Watervliet Arsenal, were made by the Pond Machine Tool Co., of Plainfield, N. J. These lathes were 138 feet long, with a swing of 9 feet, and each lathe weighed 280 tons. To facilitate transportation the bed of the lathe was built in six separate sections. The 12-inch gun-lathe was used for a turning-lathe, and the rifling-machine was extended in length and fitted for the 16-inch gun. A 150-ton traveling crane was made for this work by the Morgan Engineering Co., of Alliance, O. Instructions for manufacturing this 16-inch type gun were dated January 26, 1897, and the first forging for this gun was received at the Arsenal on February 19, 1898. In all, eleven especial machines and tools were purchased or refitted for making these 16-inch guns, the majority of them being made by the Pond Machine Tool Co.

* * *

CELLULOSE MACHINES.

In the April issue of MACHINERY a brief mention was made of the great value of cellulose as a packing between the outer and inner walls of war vessels, on account of its capacity to absorb water and swell up sufficiently to close the openings if the plates are pierced below the water line by shots from the enemy, and to the effect that the best cellulose is made from cornstalks. Mr. W. E. Willis, Harrisburg, Pa., has sent us the photograph, reproduced herewith, of a machine for the purpose of separating the cellulose, or pith, from the cornstalk, and also some interesting facts connected therewith.



Machine for Separating Pith from Cornstalks.

Maize, or Indian Corn, is, as is well known, regarded as a profitable crop by farmers throughout this country. It is used as a food for cattle, either chopped up fine while green, in which condition it is known as "ensilage," or after it is ripened and dry, although they will not, even though very hungry, eat the portion containing the pith, which is a wise provision of nature on account of the entire absence of nutriment in the pith, and besides its inevitable absorption of the juices of their stomachs, which would injure their digestion. When separated from the stalk, however, the pith has considerable value as a bedding for cattle, packing for crockery and fragile articles, and in the manufacture of hats and fancy ornaments. And, as the grain, leaves, husks, and even the cobs, have definite commercial values, it may be seen that if the proper separation of the pith from the stalk could be made, a saving of the entire ripened crop could be effected.

The separation of the pith from the stalk is not an easy matter on account of the irregular structural arrangements of corn stalks, besides their varying diameters and lengths. It is accomplished in the machine illustrated, however, in a very ingenious manner, which renders it independent of all irregularities of size and shape. In it, the entire plant as it is cut and hauled from the field is operated upon, the butts of the stalks entering foremost, and its first operation is that of nipping off the ears of corn and delivering them free from the rolls. The ears are further taken care of by being husked by an arrangement not shown. The stalks passing into the machine enter the large rolls shown and are crushed flat, causing them to split open on the edges, which reduces the stalks whether large or small to a condition in which the shell is disposed on the top and bottom layer while the pith portion is between. Then a rapidly reciprocating knife, lying in the plane of the flattened stalks as they are issuing from the rolls, and close to and slightly above the middle of the opening between the rolls, shears, or splits off, the top layer, while the lower layer and pith pass on to a second set of rolls and reciprocating knife, where a like operation is performed on the lower side of the stalk. Finally, means are provided for cutting both the shell and the pith, separately, into short lengths, together with the necessary conveyors to properly deliver the products. It may thus be seen that the entire stalk is made use of, the pith being extracted and the shell, which has value as a fodder equal to the best hay, is chopped up ready for the cattle.

The capacity of the machine shown, which is twelve inches wide, is about twenty tons of stalks per day of ten hours, one-tenth of which represents the pure cellulose. In bulk, however, the cellulose represents about one half of the stalks, as the pith resumes its normal size and shape, like rubber, after being freed from the compression of the rolls.

For use as packing between the inner and outer walls of war vessels, this pith is treated chemically to make it fireproof and is then pressed into shape for use. Experiments tried upon it under the conditions of such service have proven it capable of entirely stopping up holes below the water line by its swelling action.

* * *

NEW FITCHBURG LATHES AT THE WORKS OF THE FORE RIVER ENGINE CO.

In the June number of MACHINERY was published a description of the new works of the Fore River Engine Co., of Quincy Point, Mass. At the time the article was written the works were not fully equipped with tools, and the photographs from which our illustrations were made were taken before some of the most important machines were in place. In the main machine shop the most striking feature is a row of five 60-inch lathes designed for turning and boring nickel-steel forgings, such as crank and propeller shafts, connecting rods,

Fig. 1. Row of Headstocks.

and other large forgings necessary in the construction of heavy marine machinery. These lathes were built and installed by the Fitchburg Machine Works, Fitchburg, Mass., and are shown in the general view of one end of the Fore River Engine Co.'s machine shop, which appears in Fig. 2. A larger view of one of the lathes appears in Fig. 3, and in Fig. 1 is shown the row of five headstocks with their motor equipment.

These lathes are designed to turn pieces 45 feet long between centers, and two of the lathes have boring bar-bed extensions, making a total length of 113 feet. In designing the machines the manufacturers have made no radical change in the operating parts usual with first-class lathes of this size.

The new designs and patterns were made for the purpose of providing a very heavy, powerful lathe, in which all the parts would be able to do their full share of the work. The net weight of each lathe is 97,000 pounds, and the metal is carefully distributed, while to meet modern requirements for heavy tools electric drive has been provided.

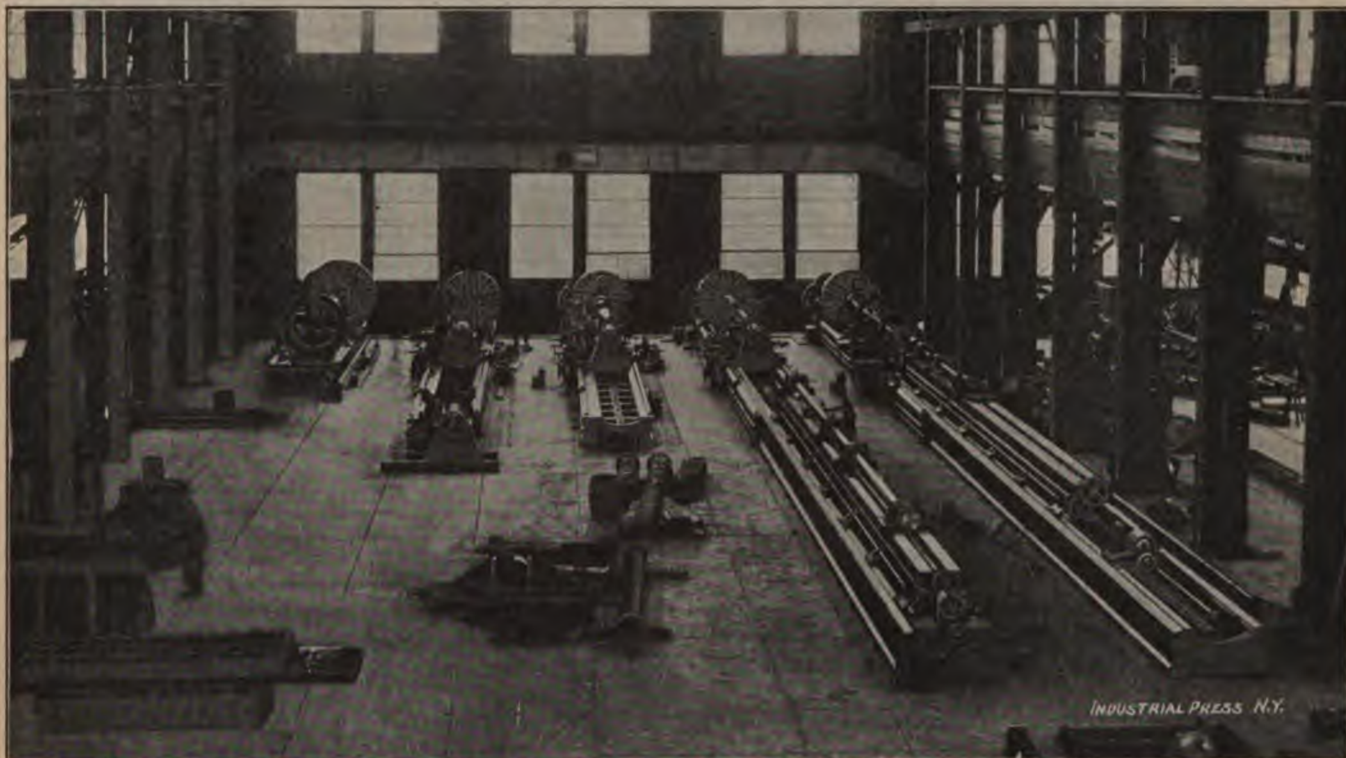


Fig. 2. Group of Fitchburg Lathes for Turning and Boring Heavy Forgings in the New Shops of the Fore River Engine Co., Quincy Point, Mass.

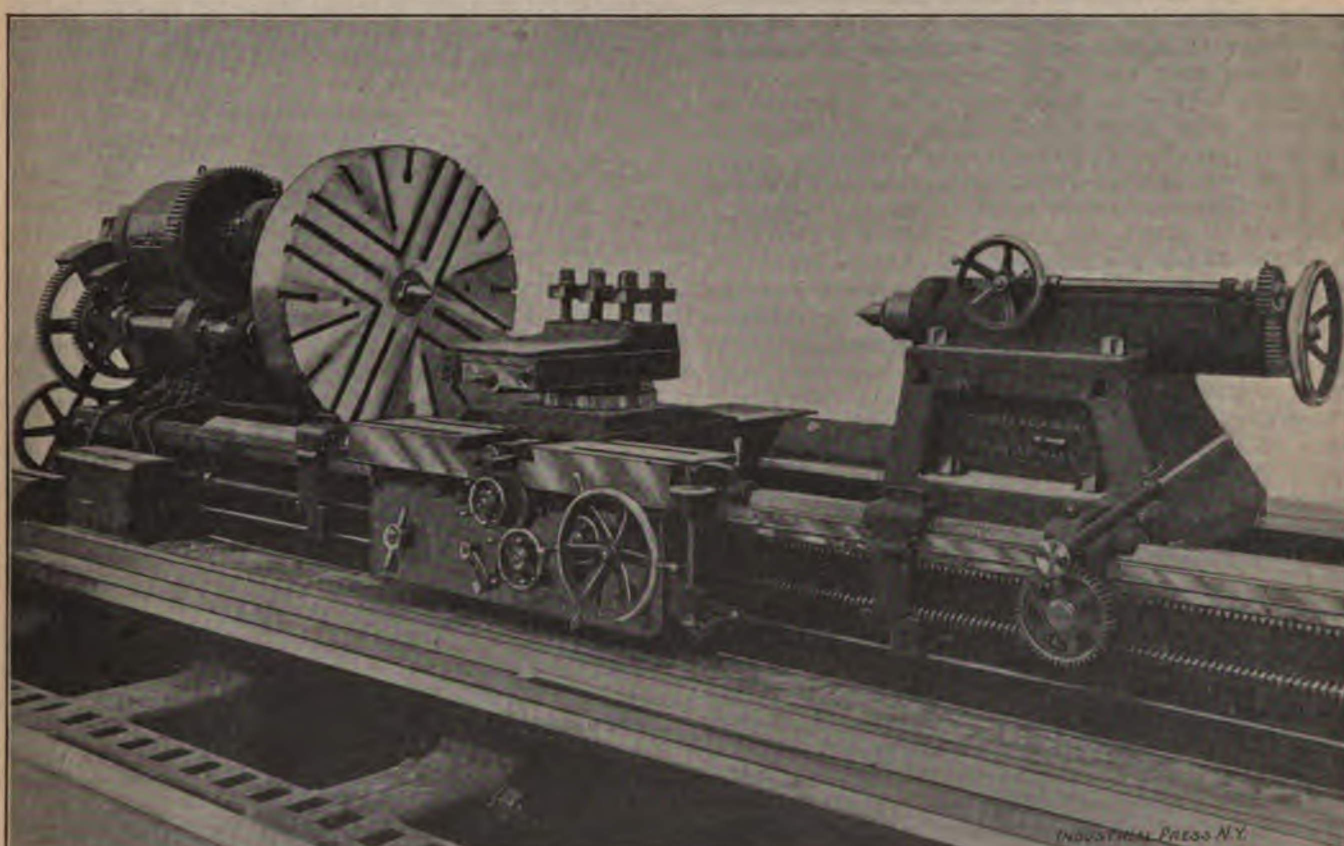


Fig. 3. General View of one of the Sixty-inch Fitchburg Lathes.

The motors, controllers and multiple-voltage system of the Bullock Electric Manufacturing Co. have been used; the motor is attached direct to the cone shaft, and was made special to give the regular cone speeds. The controller is operated by a crank on the side of the carriage, giving the motor five changes of speed, and the motor can be run in either direction by turning the crank forward or back, as desired. With the multiple-voltage system a variable speed is obtained without a waste of power in resistances in the armature circuit, as the controller supplies the different voltages directly from their sources to meet the varying conditions.

These lathes are adapted for any work where both power and accuracy are required, and they are furnished with belt drive as well as variable or constant speed motor drive. They swing 63 inches over ways, and can be made any length of bed desired.

THE FIREPROOFING OF WOOD.

METHODS OF FIREPROOFING AND RESULTS OF TESTS ON WOOD THAT HAS BEEN TREATED.

A. H. Eldredge.

In 1898, while instructor at Cornell University, the writer became interested in the fireproofing of wood, and under the advice of Prof. Roth, of the Department of Forestry, a series of experiments was begun to find what could be done toward fireproofing wood on a practical and economical basis. Mr. G. B. Preston, present State Boiler Inspector of New York State, was also an instructor at Cornell University, and assisted in the work. Soon after the work was begun, both Mr. Preston and the writer left the university to accept other positions before fully accomplishing the objects of the experiments.

The subject is one that offers a broad field for investigation, and promises to be of value to the general public in many ways. The time is coming when either the law will make it compulsory for the wood which enters into the construction of certain structures to be fireproofed, or the fire insurance rates will be such as to make fireproofing an object and thus practically to enforce it. Each year about $200,000,000 worth of insured property is destroyed by fire, many lives are lost, and much damage is done that cannot from a business standpoint be measured in dollars and cents; so that it is plain that whatever will reduce these losses will, sooner or later, become standard practice.

Wood that is used in dry places can be effectively fireproofed; as, for example, the wood that goes into the construction of a railroad train, or a sleeping car, or into a hotel, theater, office building, dwelling house, etc. In the case of a railroad train wreck it would frequently prevent the destruction of the train by fire, accompanied oftentimes by a needless loss of life.

There are two general classes of wood—i. e., hard and soft wood. The physical structure in either case is very complex. The soft wood is more homogeneous and its sap cells are smaller than in hard wood. It was frequently observed, while testing hard wood, that the smoke and gas would traverse the body of the wood three or four inches beyond the blaze. Such, however, was never the case with the tests on soft wood. This fact offers one explanation of why hard wood is more difficult to fireproof than soft wood, and why a treatment that is satisfactory in the one case is not in the other.

By fireproofing is meant the treating of the wood in such a manner that it will neither burn of itself nor propagate combustion. It does not mean that it is indestructible; it would still be possible, under high temperatures, to destroy wood that had been fireproofed, just as it is possible, under similar conditions, to warp, twist or melt the iron work of a supposedly fireproof construction.

Methods of Fireproofing Wood.

Wood can be fireproofed in a number of different ways; for example: By protecting it with some non-conductor, as asbestos; by painting with a fireproof paint, or by subjecting it to some chemical treatment. The second method has considerable merit and there are a number of fireproof paints on the market, the best of which no doubt contain more or less of some of the chemicals mentioned in this article. Whitewash is recognized as being of value as a fireproofing material, and special rates are allowed by the fire insurance companies for buildings that are whitewashed over those that are not.

The theory of the fireproof treatment is that wood so treated will evolve a gas that will not support combustion, and wood so treated will not, as a consequence, burn of itself. There are two ways in which wood burns; one is with a flame and the other with a glow. The kind of burning, whether by flame or glow, was always carefully noted in our tests.

The principal requirements of a good fireproofing material are as follows: First, it must be effective; second, it must be durable; third, it must be safe; fourth, it must be cheap. Where wood is used in dry places the first requirement is easy to meet. The second is difficult to meet where the wood is used in damp places, as the salt of the reagent will gradually seep out of the wood, thus destroying its fireproofing qualities—the action being similar to that of water on common salt. The third requirement can be easily determined by knowing the reagent used for fireproofing. The chloride of mercury (HgCl) if used will emit a poisonous gas under high temperatures, and therefore should not be used. The fourth requirement was not determined.

In selecting the reagents to be used in these tests, advantage was taken of the previous work of the chemist, and only such salts and chemicals were used as promised the best results, as follows:

Ammonium chloride	NH_4Cl
Magnesium chloride	$MgCl_2$
Calcium chloride	$CaCl_2$
Zinc chloride	$ZnCl_2$
Ammonium phosphate	$(NH_4)_2HPO_4$
Alum	$Al_2(SO_4)_3$

Method of Conducting the Tests.

The test pieces were ¼ inch square and 8 inches long. They were held by one end in a jig, at an angle of 45 deg., while the other or lower end was placed in the center of the flame of a Bunsen burner. The distance from the jig to the center of the burner was kept constant throughout the tests. The test pieces were first dried in a dry kiln, then boiled in the fireproofing solution and dried a second time, after which they were left for 24 hours in the open room so as to absorb the normal amount of moisture in the atmosphere before being burned. The first tests were conducted for strength of solution and time of treatment, from which standard strengths of 5 per cent or 10 per cent and a time of boiling of 30 minutes were adopted. By strength of solution of 5 per cent is meant that 5 per cent of the reagent and 95 per cent of water by weight were used. In no case was the test piece removed from the flame of the burner until it had ceased to burn. Untreated pieces of wood, both pine and oak, were frequently tried, and in every case they were burned up, even when removed from the flame of the burner and held in a horizontal position.

Table I. Ammonium Chloride Solution.

F., flame; F. O., in flame only. Pieces ¼″ × ¼″ × 8″.

Strength of Solution, per cent.	Time Boiled, mins.	Pine.			Oak.		
		Burned, inches.	Glowed, inches	Charred, inches.	Burned, inches.	Glowed, inches.	Charred, inches.
1.5	5	2.75	2 75	2.75	2 50	2 50	2.80
1 5	15	2 00	F. O	2.00	2.75	F. O.	2.75
1.5	30	1.75	F. O.	1.75	F. O.	1.75	F. O.
3.5	5	4.50	4 00	4.50	1.50	F. O.	1.50
3.5	15	2.00	F. O.	2.30	2.00	1.50	2.00
3.5	30	1.50	F. O.	1.75	1.50	F. O.	1 50
5.0	5	F. O.	F. O.	2.25	5 00	F O.	5.25
5 0	15	F. O.	F. O.	1.75	1.50	F. O.	1.50
5.0	30	F. O.	F. O.	1 75	2 25	F O.	2.25
Zinc Chloride Solution.							
1.5	5	F O.	F. O.	1.60	F. O.	F. O.	1 90
1.5	15	F. O.	F. O.	1.75	Bur	ned up fr	eely.
1.5	30	F. O.	F. O.	1 60	1 75	1.75	1.80
3 5	5	F. O.	F. O.	2 25	4 75	4 75	5.00
3.5	15	F. O.	F. O.	2.25	F. O.	F. O.	2 25
3.5	30	F. O.	F. O.	1.50	Bur	ned up fr	eely.
5 0	5	F O.	F. O.	2 25	F. O.	F O.	2 00
5.0	15	F. O.	F. O.	1.50	Bur	ned up fr	eely.
5.0	30	F. O.	F. O.	1 50	F. O.	F. O.	1 75

The accompanying tables illustrate the action of both hard and soft wood under the various treatments. Table I. shows the effect of weak solutions and short periods of boiling; table II. shows more uniform results with stronger solutions and a longer period of treatment; table III gives the results of an ammonium hydrate treatment that is especially adapted to moist places; table IV. is the summary of the work.

In the ammonium hydrate treatment the wood is first boiled in a solution of zinc or ammonium chloride, then kiln-dried, and next boiled in a solution of alum water. In order to save the solution of alum water the wood should be removed from the solution of alum water and placed in a boiling solution of bicarbonate of soda. This second treatment to alum and bicarbonate of soda causes a deposit of ammonium hydrate all through the pores of the wood. Ammonium hydrate is very hard; it will not dissolve in boiling water nor

Table II. Ammonium Chloride Solution.

F., flame; F. O., flame only. Pieces ¼" × ¼" × 8".

Strength of Solution, per cent.	No.	Pine. Burned, inches.	Pine. Glowed, inches.	Pine. Charred, inches.	Oak. Burned, inches.	Oak. Glowed, inches.	Oak. Charred, inches.
5	1	2.00	2 00	2.75	3.00	2.50	5.00
5	2	F O.	F. O.	2.75	3.50	2.75	5.00
5	3	F. O.	F. O.	1.75	Burned up freely.		
5	4	F. O.	F. O.	1.75	3 00	3.00	5.00
10	1	2.50	2.25	3.00	F. O.	F O.	2.00
10	2	F O.	F. O.	2.25	F. O.	F. O.	2.25
10	3	2.50	2 50	3.00	F. O.	F. O.	2.50
10	4	....	....	....	F. O.	F. O.	1.50
Zinc Chloride Solution.							
5	1	F. O.	F. O.	2.50	F. O.	3.50	3.50
5	2	F. O.	.F. O.	2.25	F. O.	F. O.	2 00
5	3	F. O.	F. O.	2.25	*7.50	6.50	7.50
5	4	F. O.	F. O	1.50	6.00	5.00	6 50
10	1	F. O	F. O	2.00	F. O.	F. O.	2.50
10	2	F. O.	F. O.	2 00	3.00	2.50	3.50
10	3	F. O.	F. O.	2.25	5.00	4.00	5.75
10	4	F. O	F. O.	2 00	4.50	2.00	5.50

* A very open piece of wood; burned slowly, finally going out.

burn in the flame of a Bunsen burner. This treatment, to a great extent, makes the wood water-, insect- and fire-proof. It imparts to the wood a bluish color that would probably spoil it for finished surfaces. None of the other treatments affected the color of the wood below the surface.

Table III. Zinc Chloride and Ammonium Hydrate Solutions.

F. O., flame only. Pieces ¼' × ¼" × 8".

Per cent Zinc Chloride	No.	Pine. Burned, inches.	Pine. Glowed. inches.	Pine. Charred, inches.	Oak. Burned, inches.	Oak. Glowed, inches.	Oak. Charred, inches.
5	1	1.75	1.75	2.50	4.50	4.00	4.75
5	2	2.50	2.00	3.00	4.00	4.00	4.75
10	1	F. O.	F. O.	2.25	F. O.	F. O.	2.50
10	2	F. O.	F. O.	2.50	F. O.	F. O.	2.50

In addition to the tests with ¼-inch test pieces, some work was done with pieces that were 1 inch x 4 inches x 18 inches and 2 inches x 4 inches x 18 inches of white pine, yellow pine, oak and hemlock. These pieces were boiled for 30 minutes in a 10 per cent solution of ammonium chloride, then kiln-dried and afterwards burned in the flame of a Bunsen burner. The greatest distance charred on any of the larger pieces tested was 7 inches for white pine, 8½ for yellow pine, 4 inches for hemlock and 7 inches for oak.

Table IV. Summary of Distances in inches Burned on any Piece Tested.

Maximum length, 8 inches. Pieces ¼" × ¼" × 8".

Name of Reagent.	Strength of Solution, per cent.	Pine. Greatest.	Pine. Least.	Oak. Greatest.	Oak. Least.
Ammonium Chloride	1.5	2.75	1.75	2.85	1.75
	3.5	4.50	1.50	2.00	1 50
	5.0	2.75	1.75	8.00	1.50
	10.0	3.00	2.25	2.50	1.50
Zinc Chloride	1.5	1.75	1.60	8.00	1.90
	3 5	2.25	1.50	8.00	2.25
	5.0	2.25	1.50	8.00	1.75
	10.0	2.25	2.00	5 75	2.50
Magnesium Chloride.	1.5	3.00	2.25	8.00	2.25
	3.5	3.00	2.25	3.25	2.25
	5.0	2.75	1.50	3.25	2.00
Calcium Chloride.	1.5	8.00	1.25	8.00	4.50
	3.5	2.75	2.00	8.00	2.00
	5.0	1.75	1.50	6 00	2.00
Ammonium Phosphate.	1.5	2.25	2.25	5.50	2.20
	3.5	2.25	1.50	8.00	1.75
	5.0	2.30	1.50	1.75	1.75
Alum	5.0	5.00	4.50	8.00	8.00
	10 0	3.00	2.75	8.00	8.00
Zinc Chloride and Alum	5.0	3.00	2.50	4.50	4.00
	10.0	2.50	2.25	2.50	2.25

The results of the experiments would seem to prove the following:

First. That soft wood is more easily fire proofed than hard wood.

Second. That the strength of solution should not be less than 5 per cent for soft wood, nor less than 10 per cent for hard wood.

Third. That wood properly fireproofed will neither propagate nor support combustion.

TOOLS FOR INTERCHANGEABLE MANUFACTURING.—4.

DRILL JIGS FOR HEAVY MACHINE PARTS.

JOSEPH VINCENT WOODWORTH.

The introduction of tools and fixtures for the production of duplicate parts of heavy machinery and tools has necessitated the devising of means and the designing of fixtures by the use of which the part, or parts, to be machined could be handled with ease and expedition. The result has been that where the proper design and construction in the fixtures has been carried out, the finished work has proved vastly superior to that done by the old methods.

In designing and constructing drill jigs for heavy parts there are a number of obstacles to be met and overcome, not found in jigs for the different classes of work shown in the preceding articles. They are in effect as follows: In the increased size and strength of the jig castings. Then in the locating and fastening points for the work, which must be so situated as to allow the work to be located and fastened within the jig with the least time and exertion on the part of the operator. Lastly in the locating and finishing of the drill bushing holes, which cannot (as a rule) be successfully accomplished by the same means used in the construction of jigs for small parts.

As the main castings of jigs for heavy parts are of considerable size and weight, it is not always possible to swing them on the lathe faceplate and finish the bushing holes, as the cumbersome shape and size of the casting make the accurate locating of the buttons a difficult task indeed. The only other method that will answer the requirements as to accuracy in the spacing and finishing of the holes is by strapping the jig castings on the table of a large B. & S. or "Cin." universal milling machine, equipped with a vertical attachment, and locating the holes by the use of the cross and longitudinal graduations, the vertical feed, a pair of 12-inch verniers, and a B. & S. height gage. First locate and drill the holes in the top of the jig with a small drill chuck that fits the socket of the vertical attachment and a short, stiff centering drill. Spacing, centering, and drilling the holes in their approximately proper position, by using the different graduations, and then going over them and finishing them to size, and in their accurate location to each other. For this use a spindle turned to fit the socket of the attachment, and insert a cutter through it, thereby having a small boring bar. Then, finding the distance from the outside of the boring bar, to the working side of the jig, deduct one-half of the diameter of the bar, and move the cross, or longitudinal feed, the number of thousands required. After the first hole is finished and a nicely fitting plug is inserted within it, finish the remaining holes on that side by working from the plug and the side of the jig with the verniers, and from the base with the height gage. The holes in the other sides of the jig can then be finished in the same manner by reversing the jig or removing the vertical attachment and working directly from the miller spindle, whichever may be found necessary. By the use of the above means all holes can be finished, and when tested will be found (after the hardened and ground bushings have been inserted) to be correct to the thousandth.

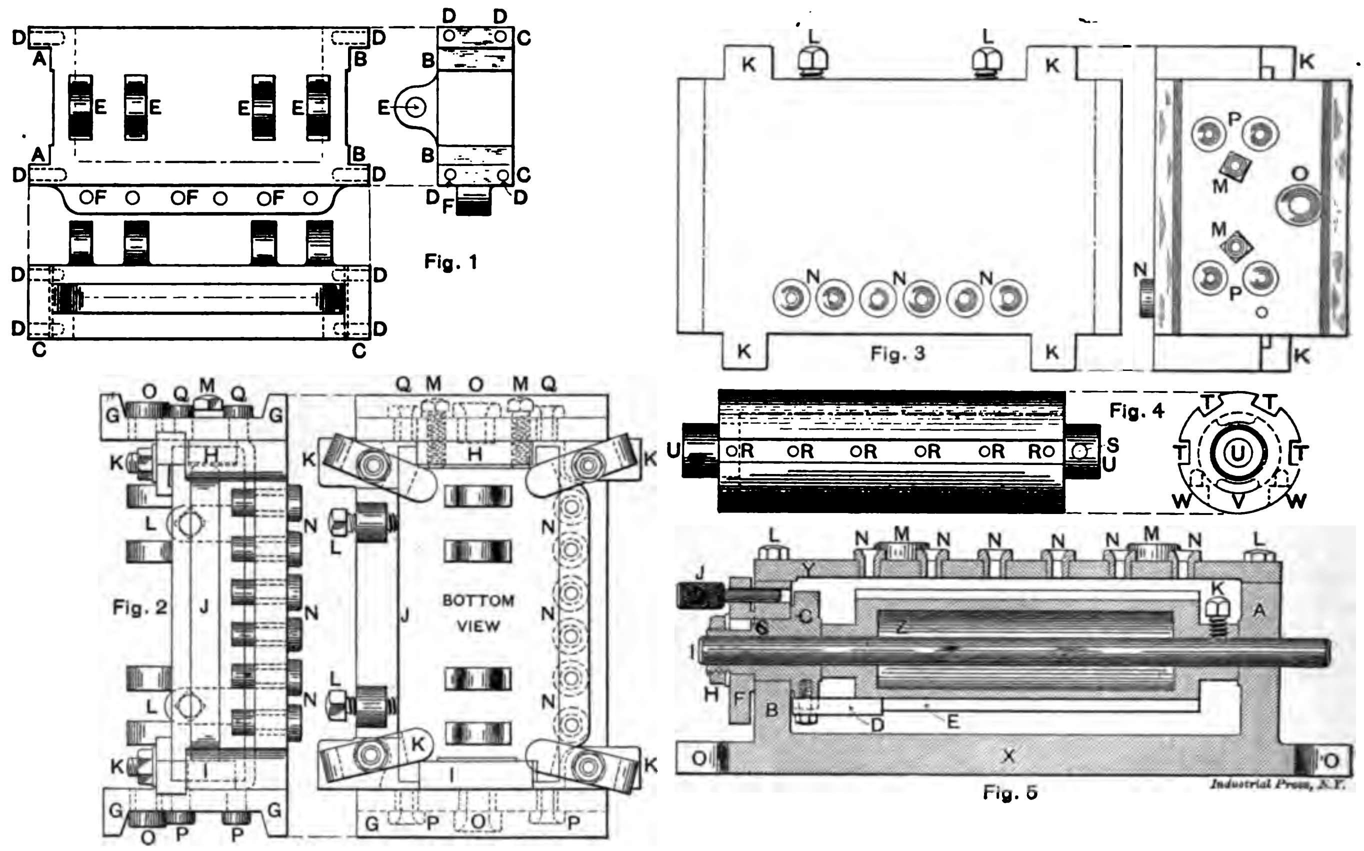
The numerous and various jigs illustrated in the accompanying illustrations show clearly the most practical design and construction for the various shaped castings shown. In Fig. 1 are three views of a cast-iron crosshead for a nailing machine. This is finished at three points, at *A A*, *B B*, and the bottom *C C*. The holes drilled are eighteen in number, four at each end at *D*, four at *E*, and six at *F*, in the front projection. The jig for drilling them is shown clearly with the work fastened within it in the two views of Fig. 2, and in a top and end view in Fig. 3. It consists of one casting with legs at each end at *G G*. The work is located by forcing it endways down on the locating piece *I* by the two setscrews *M M*, and sideways against the two locators *I* and *H* respectively, by the setscrews *L L*, see bottom view, Fig. 2. Four straps, *K K K K*, fasten and hold down the work securely on two raised and finished spots in the bottom of the jig. The bushing holes are located and finished by the method described in the begin-

ning of this series. When in use the work is fastened within the jig by slipping it down on the locating points and tightening all screws and clamps. The jig is then stood on end on the legs, *G G*, and the holes are drilled through the bushings, *Q Q*, after which it is reversed and the holes in the opposite end drilled through the bushings, *P P*. The large hole through the four projections is then finished by inserting a boring bar through the bushings, *O*, and the cored holes in the four projecting lugs of the crosshead, in which four cutters are fastened, one end of the cutter bar being fastened in the drill-press spindle and the other end running into and passing through the hole in the center of the table, as the bar is fed down. The bar is now removed, the jig turned on its back and the six holes, *F*, Fig. 1, drilled through the bushings, N. The design of this jig is as simple as possible, and allows the work to be drilled to be very rapidly located, fastened, drilled and removed. The projecting lugs on the sides for the straps or clamps, *K K K K*, strengthen the ends of the jig, and overcome the tendency to weakness in the projecting ends. The use of a boring bar with four cutters for finishing the holes, *E*, Fig. 1, is both economical and productive of good results, saving time in the finishing of the holes and insuring their alignment with each other when finished. The use of the clamps for fastening the work tends to the rapid fastening and releasing of the work, as by a single turn of the nuts they can be swung on or off.

In the two views of the cast-iron impression roller, Fig. 4, we have a piece of work that would be difficult to handle without the use of a jig. The roller is turned and finished in the lathe and then transferred to the miller and indexed for six, and the four channels, *T T T T*, are milled down its entire length. In each of these channels six holes, *R*, are drilled, and in the plain side of the roller four counterbored holes, *W W*, are let in. The inside of the roller is cored out as shown by the dotted lines, and the core vents at *V V*. A 2-inch hole through the ends at *U U* acts as a journal bearing for a revolving shaft. The jig is clearly shown in the cross-sectional view in Fig. 5, and in the top and end views of Fig. 6. *X* is the main casting, *Y* the bushing plate, and *I* the shaft on which the roller *Z* to be drilled is fastened. The locating plate *C* revolves in the end *B* of the jig and projects through to the opposite side, the index plate *F*, being keyed to it at *G*, and fastened by the nut *H*. The bushings *N* are for the six holes, *R*, in the channels, and those at *M* for the counterbored holes *W W*, Fig. 4. To locate the roller within the jig so that the channels in which the holes are drilled will be in line with the bushings, the locator *D* is used. It is fastened within a channel in *C*, by the capscrew shown, the piece *D* fitting the channel *E* snugly, as shown in the cross section, and the roller is fastened to the shaft *I* by the setscrew *K*.

In the end view of the jig, Fig. 6, the indexing holes in the plate *F* are shown—those for the holes in the channels are at *R R R*, and the one in which the index pin, *J*, is entered, four in all. That for the counterbored holes is at *Q*. The top view of the jig shows the position in which the bushings *N* and *M* are located and the manner of locating the bushing plate by the four screws *L*, and the two dowel pins *P P*. By reverting to Fig. 5 the manipulation of the jig when in use and the drilling work will be understood. The shaft *I* is removed and the roller *Z* inserted, fitting between the locating plate *C* and the finished hub on the end *A*, with the locator *D* in the first of the channels. The shaft *I* is then slipped through and setscrew *K*, in the roller, tightened. The jig is then set on the table of a large adjustable multiple-spindle drill, six of the spindles being set so that the drills will enter the six bushings *N*, and four of the remaining spindles set so that the counterbores will enter the bushings *M*. The jig is then fastened securely to the press table, by capscrews through the ends at *O*. The four holes *W* (Fig. 4) are then counterbored, first removing the drills from the other six spindles. The counterbores are then removed, the six drills refastened in the spindles, and the index plate revolved until the first channel in the work is under the bushings *N*. Index pin *J* is now entered, and the six holes drilled, when the index plate is moved for the next channel and the holes drilled in it, the holes in the remaining two channels being drilled in the same manner. The use of this jig together with the multiple spindle drill makes the handling and drilling of a heavy roller a simple operation, that would, however, be difficult to perform satisfactorily by any other means. Moreover, the work produced will be found to interchange perfectly.

A separate and distinct type of jig for heavy work is shown in the three views of Fig. 8. It is used for drilling all the holes in the dove-tailed slide bracket shown in Fig. 9, and, as will at once be seen, it can be located on the work, simply and rapidly. The bracket (Fig. 7) has four holes drilled at *V V*

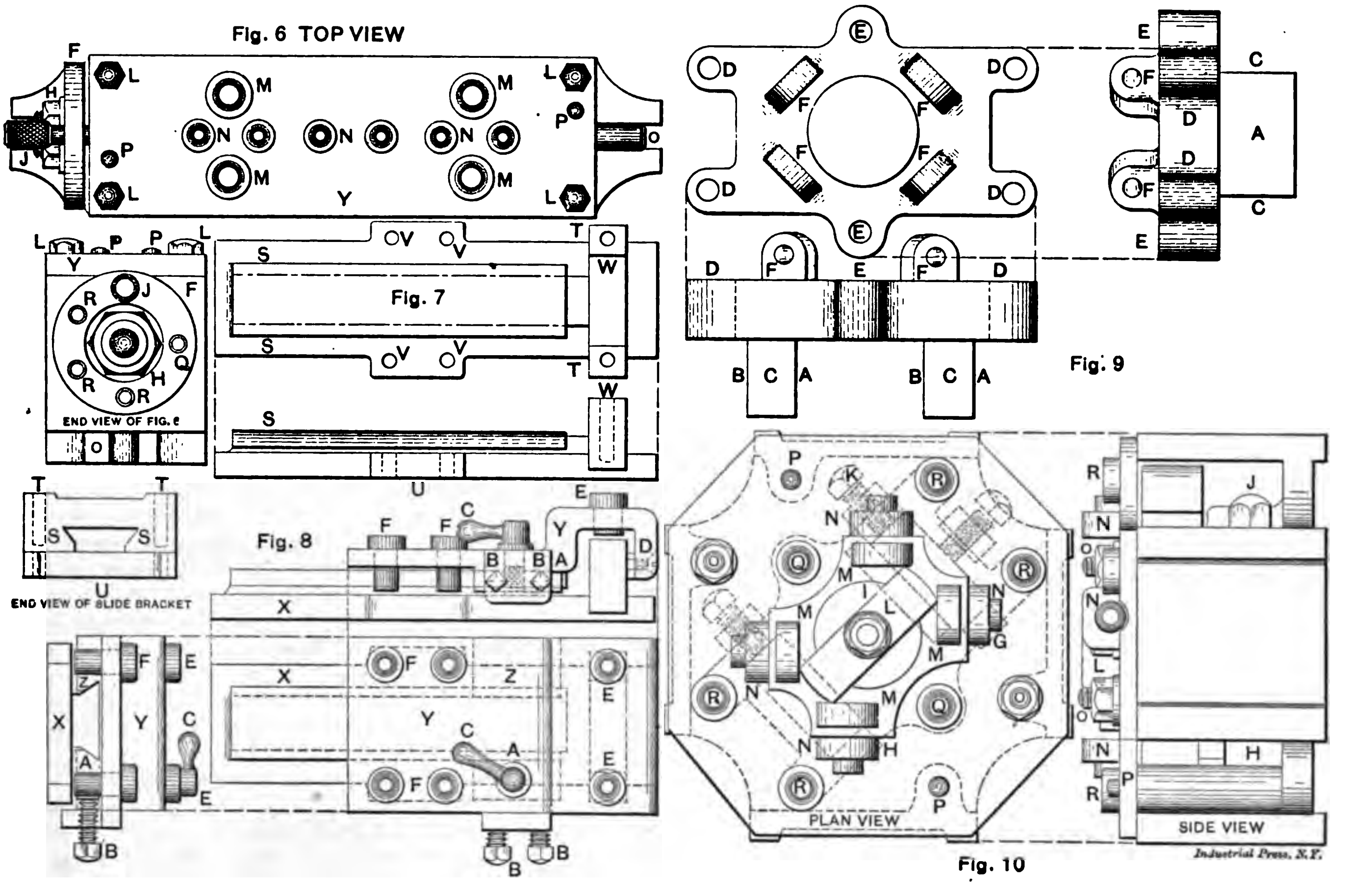


Group of Drill Jigs.

V V, and two at *W W*. The four holes *V* are for fastening the bracket to the body of the machine of which it forms a part, and those at *W W* for fastening a spindle bearing to this portion of the bracket. The casting, before being drilled, is machined on the back at *U*, planed dove-tail at *S S*, and a cut is taken off the top at *T T*. The dove-tailed surface is utilized as the positive locating point for the jig, as it is shown secured on the work in the three views of Fig. 8. The bottom of the jig and the point *Z* are finished to coincide with the dove-tailed surface of the work. The angular-faced clamp *A* is forced up against the work by the two setscrews *B B* and drawn up tight by the clamping lever and stud *C*. The end-locating point is at *D*, which consists of a flat steel plate fastened to the overhanging end of the jig by two flat-head screws. The four bushings *F F* project down almost to the face of the jig, this being necessary, as the casting at this point was not machined. When being drilled, the casting rests on the back *X*, and the jig is located and fastened on it as shown in Fig. 8. The holes drilled, the jig is quickly removed by loosening the two setscrews *B B*, and the clamping lever *C*, which allows the clamp *A* to be slid back, and the

The casting, as can be seen, is a rather difficult one to handle, but by the use of this jig the drilling is accomplished with ease and expedition. The only finishing done on the casting, before drilling, is to plane all sides of the two oblong projections, as shown at *A A*, *B B*, and *C C*, to gage. The holes drilled are the four *D D D D*, the two *E E*, and one through each of the projections *F F F F*.

The jig (Fig. 10) is in two parts, the lid and body casting. There are legs on four sides and on the bottom. The casting to be drilled is located from the two oblong projections on the back, as shown in the plan view, by the locating spots *G*, *I*, and *H*, and the setscrews *K K* and *J*, the large strap *L* holding it securely in the bottom of the jig. The lid is located by the two nuts *O O*. The bushings *N*, through each of the projecting lugs on the face of the lid, are for the holes through *F F F F*, in the work. The four bushings *R* are for the holes *D* and those at *Q Q* for the holes *E E*. When the jig is in use the work is located and fastened within it, as shown by the dotted lines in the plan view of Fig. 10. It is then rested on its back and all the holes in the face are drilled. The holes in the projecting lugs of the casting at *F* are drilled by stand-



Another Group of Drill Jigs.

jig removed. The design of this jig gives a practical illustration of how simple and inexpensive tools for the drilling of heavy parts can be constructed, by choosing the most adaptable locating points on the work, and designing the jig castings so as to have as few points as possible to machine. When locating and finishing the bushing holes in this jig, it was first finished at all points necessary, and then clamped to the slide bracket, or work, which was in turn clamped to the miller table, with the top of the jig up. The holes were then located and finished by getting the distances from the machined surfaces of the work and using the vertical attachment, thus doing away with the necessity of first laying out the holes on the work, then finding their location in the jig. This is a very good plan to follow, when the shape of the jig castings will not allow of their easy fastening to the miller table. Moreover, in getting the distances between the bushing holes, the machined surfaces of the work are reliable points to measure from.

Fig. 10 shows still another jig, in two views. It is for drilling all the holes in the press bolster shown in Fig. 9.

ing the jig on each of its sides in turn and drilling down through the bushings *N*. In this jig the amount of time taken to locate, fasten and then drill the work amounts to very little, when the shape and bulk of the casting is considered. Jigs of this design can be used to the best advantage for the drillings of heavy castings on which are a number of projecting lugs, and when holes are to be drilled in them to a given line, or in line with each other, as in the case of the casting drilled in this one.

* * *

At the West Oakland shops of the Southern Pacific Railway a method is in use for welding cracked locomotive frames in place. A small furnace of fire brick is built around the frame at the crack and an oil burner is then introduced and operated till the frame is brought to a welding heat. At the June meeting of the Pacific Coast Railway Club, Mr. Kellogg, the foreman of these shops, stated that an engine was recently brought in off the road at 8:30 A. M. with the main frame broken under the rocker box. In 22 hours the engine was back on the road hauling its train.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

SEPTEMBER, 1901.

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MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

1900.		1901.		1901.		1901.	
Oct.....	24,000	Jan.....	27,500	April....	26,000	July.....	28,964
Nov.....	25,000	Feb.....	26,500	May.....	26,500	Aug.....	29,492
Dec.....	27,500	Mar.....	30,000	June....	28,000	Sept.....	28,165

No other paper in this field prints its circulation figures.

Tempering, annealing and case-hardening are three subjects upon which there has been very little practical information published. We solicit communications from any readers who have had experience in this class of work.

* * *

SKILLED MECHANICS VS. CHEAP LABOR.

In an editorial aftermath upon the machinists' strike, the *Iron Age* recently expressed sentiments concerning shop management and the employment of labor that we cannot consider other than representing a short-sighted shop policy.

Attention is first called to the well-known facts that many lines of manufacture have become so specialized that the skilled mechanic is often virtually "out of it," his place being taken by the machine hand or operator; and that all men working at tools in the machine shop are not skilled mechanics and cannot receive mechanics' wages. Then at one stroke the writer wipes the skilled mechanic out of existence by adding that "even in general shops the tools now in use are capable of being easily mastered by men of fair intelligence with some little education."

By way of illustration the following instance is related:

"In a certain shop a large planer was installed. It was a much bigger tool than any other in the shop, and represented quite a change in the equipment. A competent machinist was given charge of the planer, and after running it for a month he asked for an advance in wages, claiming that he should receive higher pay on account of its greater size and the heavier work turned out by it. He was given another job and a second man was assigned to the machine. In a short time he made the same demand, and a third man was put in charge of the planer, with whom the manager had a like experience. Growing tired of this result of putting good mechanics in charge of what he considered a very simple tool, the manager went to a laboring gang and asked the foreman to point out some man from among them of fair intelligence and a little education. Such a man was at once designated, and the manager conducted a civil service examination, as follows: "Can you read and write?" "Yes." "Have you ever worked in a machine shop or at any kind of a machine?" "No." This being deemed satisfactory, the man was taken into the machine shop and put in charge of the planer, and after a course of instruction extending over two or three weeks he was able to manage the tool without supervision, and was regularly employed to operate it from that time. The selection of this man was designed as a lesson to the men in the shop, who were persistently demanding higher wages whenever they could frame a pretext, usually a claim for superior knowledge or expert skill."

We do not know what shop this is, or anything about the circumstances of the case. The laborer may or may not have made a good planer hand, and the conditions may or may not have warranted the step that was taken. These features are of no particular moment, since it is the principle involved rather than the particular incident that we wish to comment upon. The policy is above outlined of employing men upon general work who have been "broken in" so as to mechanically perform this or that operation, but who have had no particular mechanical training such as a skilled mechanic of sound judgment must have. This policy we take exception to.

We are well aware that men of genius may be found in the ranks of laborers as well as among those in better circumstances, and we are glad when they have the opportunity to show their ability. No laborer, however, can become a competent planer hand without the experience and training commensurate with the work that a planer hand has to do. He may get this experience while he still goes by the name of "laborer," or he may get it afterward, but he must somehow obtain it. We predict that in the above-named shop the actual planer hand was not the laborer at all, but was his four-dollar-a-day foreman who might better have devoted his time to saving the company dollars per hour than in assisting the laborer in saving the company cents per day.

Suppose, Mr. Manager, that the treasurer of your company were a practical man, and that he decided your $2,500 services were no longer needed. Suppose he thought that your young assistant could run the shop at $1,000 a year, by keeping one eye on affairs himself. This would be carrying your policy to an extreme, it is true, but it is a poor rule which does not work up and down the line. Suppose, moreover, that you adopted the plan of employing men, who were not skilled mechanics, on all the machines in the shop. Where would you find a man for responsible work when you had such work to be done, and where would you obtain a foreman when you needed one?

We believe the best results are obtained where the average intelligence and ability of the workmen are high and the number of foremen employed few, rather than where the averages of intelligence and ability are low and the number of unproductive foremen employed to oversee the work is large. Where the former conditions exist good wages must be the rule, and we believe they represent money well invested. While requests for more pay are not always pleasant, we see no reason to deprecate them, since progress is impossible without ambition, and ambition is impossible without hope of something better ahead. In many shops the practice is adopted of giving an occasional increase without the asking, where a man has proven himself worth the money, which is a still more desirable method.

In spite of the introduction of automatic machinery, we believe there never was as good a chance for skilled mechanics as to-day, not only in the general machine shop, but in repairing and overseeing the automatic machinery which cheaper labor can operate. To become a skilled mechanic of to-day, moreover, one has much more to learn than was required fifty years ago, because there is so much more accumulated knowledge that he needs to have at his disposal. In spite of the introduction of automatic machinery, also, there were never so many machines of standard type in use in the general machine shop, and there never was a time when they required as careful and capable operators as at present, our contemporary to the contrary, notwithstanding. The tendency of the times is to increase the efficiency of each individual machine. It is made to operate on harder metals, to take heavier cuts, and the parts to move more quickly. Planers are constructed with four heads, instead of two, and they are expected to operate on a row of castings as long as the length of the bed instead of on single pieces. Lathes have improved systems of gearing, and often two toolposts instead of one. It is not necessary to mention the various improvements of recent years, but to get the most out of standard tools as they are built to-day requires more good judgment and actual skill than was necessary a few decades ago, when machine tools were comparatively simple mechanisms and scraped the metal off, so to speak, instead of slicing it.

NOTES AND COMMENT.

Brattleboro, Vt., has 7,000 population, and there is an automobile owned in the town for every 636 inhabitants. The people who live there are ordinarily well to do, few being counted as wealthy and few as poor. It is a typical New England village and if it represents average conditions for similar places, to say nothing of the cities where more wealth is concentrated, there is plenty of work ahead for automobile manufacturers.

An American mowing and reaping machine drawn by a pair of camels is hardly according to the fitness of things; but that camels are used for this purpose in countries where they are the common beast of burden is attested by the reproduction of a photograph of such an equipment in a recent magazine. In the meantime the Deering Harvester Co., Chicago, Ill., has built an automobile mower operated by a 4 horse power gasolene motor, and many other "auto" mowers and reapers are likely to follow. Customs differ.

The magnitude and importance of the pressed steel car industry is rapidly becoming evident. The Pressed Steel Car Co. have completed an order for seventy large capacity pressed steel hopper ore cars for the Great Southern Railroad of Spain. They were shipped from Pittsburg over the Baltimore & Ohio in a solid train of thirty-two cars. The new cars were packed in parts ready for shipment by steamer. An engineer from the Pressed Steel Car Co. will superintend the erection of the cars on their arrival in Spain. These cars are wider in gage than our cars, and every tenth car has a shelter box for a trainman built at one end and raised high enough to give an unobstructed view of the whole train.

THE LARGEST STEAMER.

The White Star steamer "Celtic," the largest vessel ever built, arrived at New York August 5 on her first trip. She was built at the works of Harland & Wolff, Belfast, Ireland, and was launched April 4, 1901. She is a slow boat, having engines of only 14,000 horse power, although her total displacement, full load, is about 38,000 tons, and registered tonnage is 20,880 tons. Her average speed on the first trip was 14.95 knots (17.2 miles per hour). She is a twin-screw ship, the screws being driven by quadruple-expansion engines. The diameters of the cylinders are 32, 47½, 68½ and 98 inches, all having a common stroke of 39 inches. The "Celtic" is designed for carrying freight, and passengers who care more for comfort than speed when making an ocean voyage, and because of her great size and comparatively slow speed the conditions for carrying freight cheaply and transporting passengers with little seasickness are extremely favorable. Her total length is 700 feet, breadth 75 feet, and depth 49 feet. There are nine decks, known as lower orlop, orlop, lower, middle, main, upper, bridge, upper bridge and sun decks. She has accommodations for 2,859 passengers, and carries a crew of 335 men.

BROOKLYN BRIDGE BREAK.

The discovery on July 24 that nine of the suspender rods on the Brooklyn Bridge had broken, and that the bridge floor had settled, caused a mild panic among the patrons of the bridge and much uneasiness of the officials in charge. It is well known that the bridge has long been subjected to a greater load than it was designed to sustain, and it was conjectured that this failure was a note of warning that the bridge is unsafe for the heavy traffic passing over it. Subsequent investigation, however, shows that with proper care and some alterations the bridge is good for many years to come. Owing to the large mass of metal in the cables supporting the structure there is a considerable difference in the amount of expansion and contraction of the cables and the metal trusses that support and stiffen the roadways. This inequality is compensated for by a slip joint at the center of the bridge, the trusses being fixed at each of the two towers, and each half sliding upon the other in the expansion joint at the center. The trusses are suspended by rods fastened to bands around the cables, and there are journals or trunnions at the bottom of the rods having a bearing in the trunnion blocks attached to the framework. The object of the trunnion blocks is to allow the suspender rods to swing one way or the other as much as necessary to compensate for the motion due to the expansion, or contraction, of the trusses. It seems that the trunnions have not had proper care and many of them have rusted in the blocks, preventing any rotary motion between the two, and making it necessary for the rods themselves to bend every time the lengths of the trusses changed through the action of heat or cold. The final outcome could not be other than the breakage of the shorter rods. They began to give away at the center of the bridge, where they are the shortest, and each one that broke threw additional stress upon the others, which hastened their deterioration. It should also be said that the construction of the blocks is such that it is difficult to give them proper lubrication, even when the bridge is thoroughly looked after, which it is claimed it was not. It is possible that an improved form of block will be substituted for those now in use, and it is to be hoped that the politics connected with the care and supervision of the bridge will not interfere with more competent supervision in the future than it has had in the past.

PROGRESS IN SHIPBUILDING.

The extent to which shipbuilding is now being carried in this country is unprecedented. Two new yards have recently been equipped, one of these being the Trigg Co.'s yard at Richmond, Va., and the other the Fore River Engine Co.'s plant at Quincy Point, Mass., which was described in a recent number. The former of these is now building the protected cruiser "Galveston," and the latter is building the protected cruiser "Des Moines," and has contracted for two of the largest battleships. The Eastern Shipbuilding Co., New London, Conn., are prepared to compete for the largest work, and have under construction two steel steamers for the Great Northern Steamship Co. and Northern Pacific Railroad. These will be the largest freight-carrying steamers in the world, having about the same dimensions as the "Celtic," the largest ship afloat. The immense new yard of the New York Shipbuilding Co., Camden, N. J., has contracts for four steamers for the Atlantic Transport Line, all of them very large vessels. The Boston Steamship Co., a new organization, also has two vessels under construction for foreign trade, and two are building at Sparrow's Point, Md.

All of the old yards are crowded with work. The American Shipbuilding Co. has under construction at its various yards on the lakes twenty-five vessels, while other lake builders have contracts aggregating $9,000,000. The yard at Newport News, Va., has under construction or contract a larger tonnage than any American yard has ever had up to this time, including six cruisers and battleships for the government, and an equal number of merchant steamers of unusual size. Two of these are Pacific Mail steamers, which have already been referred to in our account of the Newport News works published some time ago. The Union Works, of San Francisco, are building five vessels for the navy, and two large merchant steamers for the American-Hawaiian Steamship Co. Three battleships are being built by the Cramps, who have also in hand two 12,000-ton ships for the Red Star Line. Most of the coast shipyards also have orders for freight and passenger steamers for the coastwise trade.

The outlook for the future is quite as satisfactory as the record of the past. In addition to an increasing amount of merchant work there will be more vessels building for the government than at any previous time. Fourteen warships have been contracted for during the past year, and the construction of four more has been authorized. There is to be a new shipyard at Chester, Pa., the company for which has been organized with a capital stock of $3,000,000. It has also been rumored that capitalists are to establish one of the largest drydocks and shipyards in the world on the New Jersey flats, a short distance west of the immigration station on Ellis Island, in New York harbor. The drydocks, if built, will accommodate the largest ocean steamers, and any ship entering the port of New York will be able to enter them for repairs.

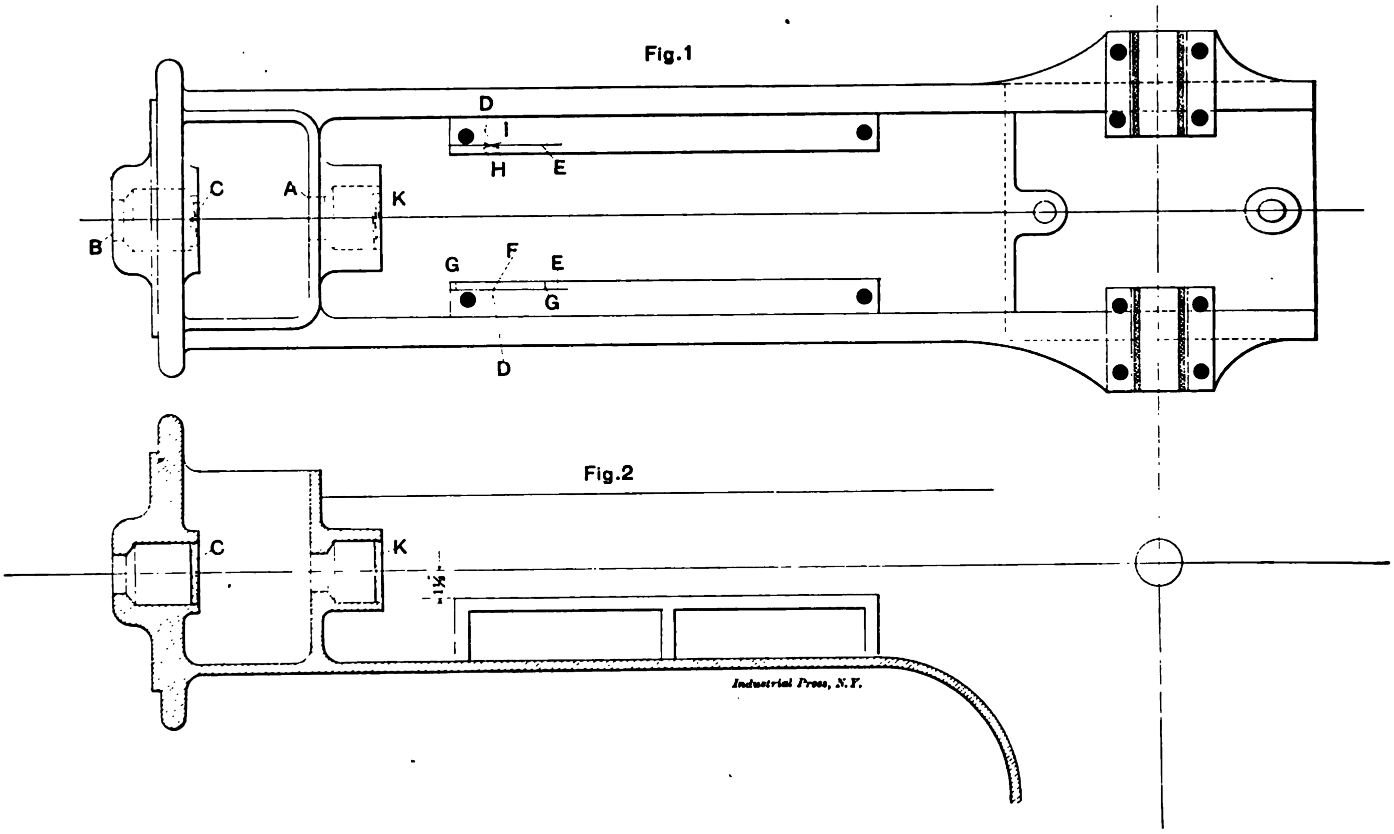
LETTERS UPON PRACTICAL SUBJECTS.

LOCATING TROUBLE ON A POWER PUMP FRAME.

Editor MACHINERY:

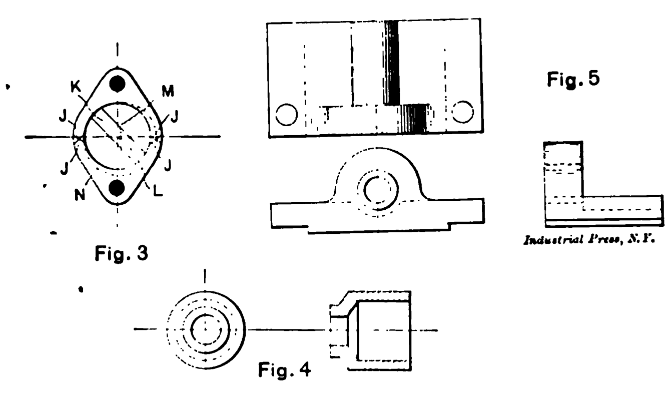
Not long since I was directed by the general foreman of the shop to look up and report trouble on 18 x 12 power vacuum frame that was being erected.

After looking it over and inquiring of the man who was erecting the pump, I found the piston rod would bear hard at point *A* and *B* in the throats of the stuffing boxes, and it



Power Pump Frame.

was impossible to move the cross-head the whole length of stroke. The pump was nearly completed and it would have been quite a job to tear down the whole thing and square up on the table and locate the stuffing boxes in relation to the counter-bore and cross-head race-way. It would be cheaper if I could locate the trouble without this work, so I went about it in this way:



First I wanted to know if the stuffing box next to the cylinder was in line with the cross-head. I placed a stick in this box at *C* and found the center, and from this center struck arcs *D D* on the cross-head race-way. Lines *E* were then drawn parallel with the edge of the race-way, cutting arcs *D D*. From *F* as a center I drew arcs *G G*, and from *G G* as centers struck arcs *H*. I found that these arcs crossed at point *I* on the straight parallel line on the race-way, at the intersection of arc *D*, which convinced me that the stuffing box *C* was central with the race-way, and hence with the cross-head.

The trouble must therefore be with the stuffing box *K*. Fig. 3 is a front view of the face of this box, showing the lines that were laid out to determine whether the center of the box was correctly located. Using *I* and *F* as centers, I struck arcs *J J J J*, Fig. 3. I then placed the stick in position in this box and drew line *L* across it from the points of intersection of lines *J J J J*. I then drew line *M*, which, according to the drawing, should intersect the center of the stuffing box at a point 1½ inches above the top surface of the race-way. The intersection of lines *L* and *M* gave the true center of the stuffing box, and it was found that the stuffing box had not been bored true with this center. From this center I laid out circle *N* large enough so that by boring to the line we would get a round hole. After reporting the matter it was decided to rebore the stuffing box. It was found that after this was done the stock left would not be strong enough to stand the pressure of the packing, so the hole was bored large enough to take a steel bushing, shown in Fig. 4. Fig. 5 shows a fixture I designed for clamping on the race-way for a guide in boring the box with a bar. This was done before with a long mill and nothing to guide the bar except the throat of the stuffing box, and the mill would thus be liable to crawl in almost any direction. C. W. PUTNAM.

Holyoke, Mass.

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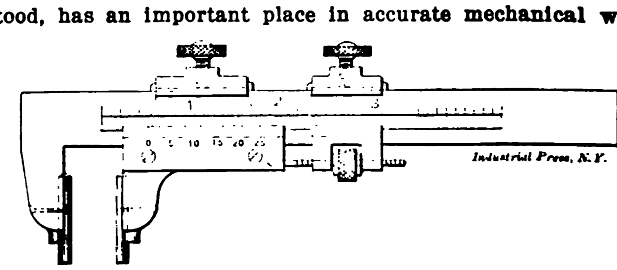
A THREE-INCH OPEN-SIDE VERNIER CALIPER.

Editor MACHINERY:

A vernier caliper, when correctly made and well understood, has an important place in accurate mechanical work.



Open-side Vernier Caliper.

The accompanying illustration represents one form of an open-side-reading vernier caliper gage designed by the writer. The vernier plate on this gage is twice the length of that

on an ordinary gage reading to thousandths of an inch, which brings the reading on every second line, instead of every line, as when a caliper bar is cut to fortieths of an inch. It is easy to read and admits of the vernier plate being cut so as to allow readings of 1-2000 of an inch. The writer has a 6-inch tool-steel open-side vernier gage on which the vernier scale plate reads to 1-2000 inch, twice, that is, the vernier plate is double, and consequently the obtaining of a correct measurement by it is assured by two separate readings. It is in every way better than the ordinary commercial vernier caliper. In the gage shown in the illustration, the caliper bar is graduated in inches, subdivided into tenths and fortieths of an inch to a length of 3 inches. The vernier plate reads in thousandths of an inch for 25 thousandths, or through each scale division of 1-40 inch.

The caliper points are two tool-steel plugs, hardened and ground true, each to ⅛ inch in diameter by 1 inch long. A seat is made for each plug in each jaw of the gage by carefully drilling and reaming a hole between the jaws when they were brought together and mounted. The two screws, shown tapped into the plugs, serve to assist in holding the plugs in place when they are finally located in their exact position. The plugs should also be "sweat" in position, as, when thus located, they will not get out of place, unless, perchance, they get into the hands of some "mechanical ruffian," for whom a "monkey wrench" would be a far more appropriate measuring tool than any correct gage. Some mechanics may object to the circular form of the inside of the plugs in the jaws for measuring, but, if so, they may be ground flat on the inside. The object of using two separate plugs is that a higher grade of steel may be used than it is convenient to construct the caliper itself of. There is no real objection to the use of round inside faces when the high-grade steel is made use of, which may be hardened so that no wear can take place on them in years of use, and especially since, even in any case of breakage or wear, new ones are easily substituted. There are cases where the circular inside faces are useful, as the arrangement allows of accurate inside and outside duplication of sizes.

The plugs touch at a regular reading, and as the two plugs of ⅛ inch diameter make ¼ inch, it is only necessary to set the vernier ¼ inch under reading for inside measurements.

F. W. CLOUGH.

Orange, Mass.

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PRACTICAL HINTS.

Editor MACHINERY:

I had occasion to cut a small but very accurate keyway in a small shaft, using a shaper for the purpose. I laid out the keyway by first striking a center line *A B*, Fig. 1, across

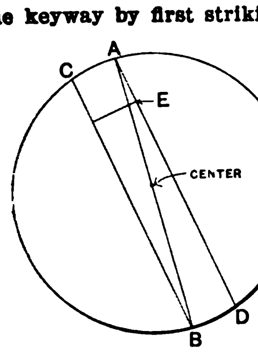

Fig. 1.

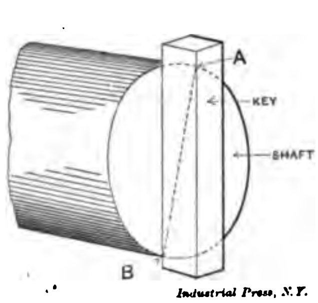

Fig. 2.

the end of the shaft, and to get the width of the keyway placed the key across the end of the shaft so that opposite sides would touch the ends of the line *A B*, as indicated in Fig. 2. Then with a scriber I marked the shaft on each

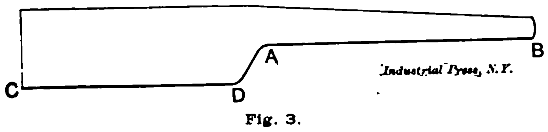

Fig. 3.

side of the key, as at *AD* and *CB* in Fig. 1, which gave me the sides of the spline exactly true with the diameter of the shaft, and without taking any measurements whatever. The shaft was then set true in the shaper by squaring with the tool to the line *AD*. The distance *A C* gave the width of, and *A E* the depth of the spline.

It frequently happens that one has a long and small hole to bore, and if a large and stiff tool is used it has to be blocked up and tilted to keep the under side of the back end from striking the bottom of the hole. To overcome this, have the tool forged as in Fig. 3, with side *A B* parallel with *C D*.

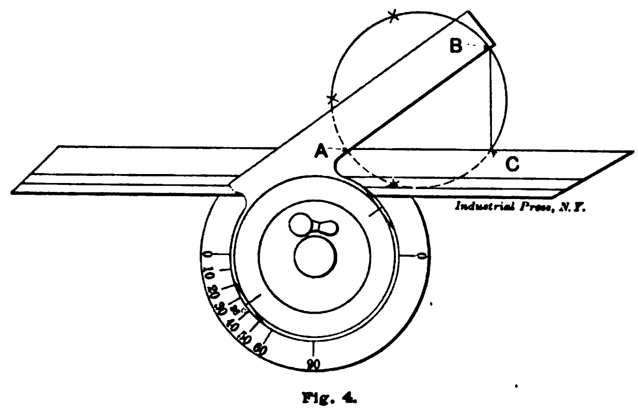

Fig. 4.

In a recent number of your paper I noticed a description of an adjustable centering square for finding the sides of a polygon. The same thing can be done with any bevel protractor as follows: Let $A = \frac{180}{N}$, where A = angle at which to set the protractor and N = number of sides of polygon.

When set, place one edge of the protractor on the center line *A B*, Fig. 4, with the points of the angle on the circumference, as at *A*, and mark where the other edge of the

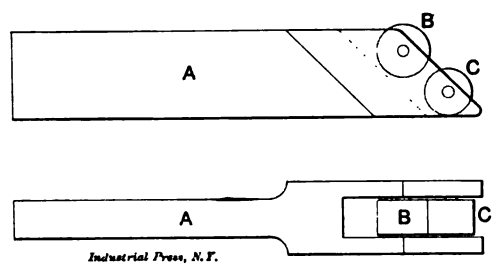

Fig. 5.

protractor cuts the circumference, as at *C*. Then *C B* will be the length of one side of the polygon. In this case it is a pentagon.

Fig. 5 shows a handy tool for trueing shafting when centering, without marring it. The body *A* is made of machinery steel and the two rollers *B* and *C* are tool steel, hardened and ground true. This tool, when held in the tool post and run up against a revolving shaft on the square center, will true it almost instantly.

SPLINE.

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NOTES ON KEYS AND KEYWAYS.

Editor MACHINERY:

Under certain conditions keyways make a great deal of trouble for the key fitter, and the object of what follows is to mention some of the difficulties that are likely to be met and to explain methods of overcoming them.

One of the troubles is when the keyway is cut on an angle with the center line, as in Fig. 1. Such a keyway should be recut if very much out, as it is difficult to get a proper seat and bearings for the side of the key. Another trouble in long keyways comes from the variation in the stock of some shafts, and from hard and soft spots, making the keyway too narrow in places and too wide in others. This means that the keyfitter must straighten out the keyway before it is in proper condition to use. Still another trouble comes when the keyway in the bushing or piece that fits the shaft is not cut parallel with the center line, causing the key to bear at one end on one side and at the other end on the other side. Especially is this so when there is a double keyway with the center line of one keyway at an angle with the other and both off the true center line of

the bushing. Another trouble, also, comes when keyways are not cut exactly opposite each other in the shaft.

A handy tool for fitting keys is made like Fig. 2. One side is cut standard depth, while the other is 1-64 inch deeper than standard, the width being the same as the keystock. It is made of tool steel, tempered, a saw cut is made through the center and the end closed a little so as to hold the key. The portion not split should be worked out so that the key will go in free, which leaves the clamping to be performed by the split end, which is done in a vise. One side is cut 1-64 inch deep to allow for variations in the key. The keyways are supposed to be cut within limits of from exact size or standard to .001 inch small, so that the keystock, which is .002 to .005 large, will have a little stock for fitting.

By the aid of this holder work can be done on one-half the key to fit the shaft, and then by turning over the key the other half can be fitted to the piece going on the shaft. Forms can be made like Figs. 3, 4, 5 and 6, as well as others.

In Fig. 3 one keyway is larger than the other. Fig. 4 shows one keyway wider and off the center with the other; Fig. 5, half a key with round ends and half square; Fig. 6, one-half of key at an angle with other half.

When the keyway varies in width in a shaft, due to hard and soft spots, a cutter the size of the key, made by milling teeth in the sides (mill teeth so that the angle of cut on one side is opposite to that of the other, Fig. 7), can be forced along the keyway to make it of even width the entire length. To do this a bushing should be made to hold the cutter and a plate fastened to one end to form a stop to back it. Then for the keyway in the bushing or piece that is to go on the shaft, put this cutter in the keyway of the shaft, back it with a collar held in place by set-screws and force the piece over the cutter. This will make the keyway match in both pieces and correct the errors unless they are excessive. For double keyways true one keyway first and then the other by it, using a key in the first keyway to hold the bushing in position.

Great care should be taken in cutting keyways in change gears. If there are one or two a little large it is necessary to bring all the others up to them and make a special key. This can be done by broaching with a cutter like that just described. It should be made to the size of the keyway that is large and fastened in a short shaft with a central keyway. It can then be forced through all the gears, bringing them to a uniform size.

In cutting double keyways where one keyway must be directly opposite the other, a cutter-setting template can be used. For use on a shaft it may be constructed as in Fig. 8, which consists of a slotted ring, the slot just the width of the cutter and a set-screw with a slightly tapered teat to fit the keyway that is already cut. For the bushing or piece that goes on the shaft the same template can be used. Put the template on a shaft above the part that is to have the second keyway cut. The part to be cut is held in position by a key, then the second keyway can be laid off or the cutting tool located. Fixtures for indexing the parts in cutting double keyways will pay where there is enough of such work, as they will make the work nearer accurate and lessen the time required by the keyfitter.

With all the tools one can contrive it still remains for the workman to exercise judgment and skill, or he will be sure to remove more stock than necessary and have a loose fit or spend too much time on the work.

Providence, R. I. EDWIN C. THURSTON.

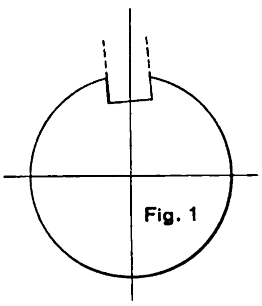

Fig. 1

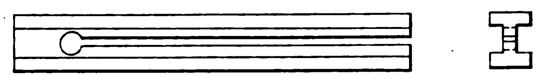

Fig. 2

Fig. 3

Fig. 4

Fig. 5

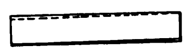

Fig. 6

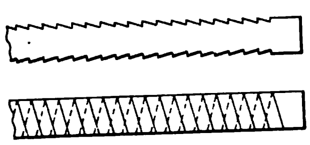

Fig. 7

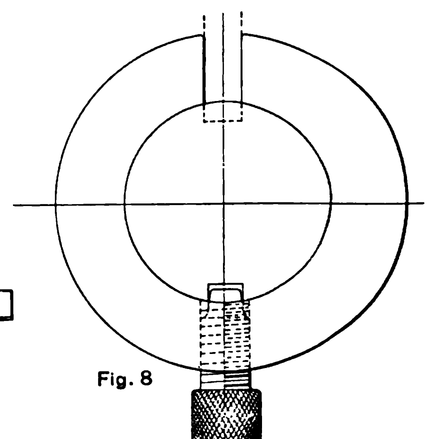

Fig. 8

Industrial Press, N.Y.

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JIG FOR MAKING THREAD CUTTERS FOR SECTIONAL PIPE TAP.

Editor MACHINERY:

The special jig used in making the thread cutters for the section pipe tap which was described in my letter to MACHINERY for June has proved of interest, and herewith are presented the diagram and description of the same.

In the diagram *E f* is a holder of machinery steel, with eight slots milled lengthwise and equally spaced upon it to receive the blank cutters, as shown at *B*. The blanks, which are 3 inches long, are held firmly in the slots by the nuts, *A* and *A'*, which are screwed up against both ends of the blanks. The nuts are made of tool steel and hardened, slightly conical on the inside and flattened on two sides for the wrench, as shown in the end views, *A* and *A'*. The blanks may be held very much more securely if their ends are planed or milled off about 5 degrees, as shown in view of cutter at *B*, and also a great deal of trouble from variation in length may be avoided by beveling a number of the blanks together and keeping them together until entirely cut. The diameter of the holder at *C* should be just large enough so that the thread tool will clear it.

The slots are cut in the holder so that the blanks come behind the center, and besides are tilted so as to throw the foot of the blank away from the center of the holder about 1-16 inch, as shown at *G*. This tips up the heel of the blank so that in the cutting of the thread sufficient clearance is insured, as is shown in the sketch at *D*. The clearance that is obtained in this way appears to be an ideal clearance for our work, and I see no reason why it should not give satisfaction on any work of a corresponding diameter; that is, on 1¼-inch pipe.

We use these same cutters in our 1, 1¼, 1½ and 2-inch pipe tap. However, in our 1-inch tap, we have to mill our slots a little ahead of the center to get the same clearance on account of the 1 inch being a smaller circle, or the cutters would ride on their heels. The amount which they are placed ahead of center is hardly 1-64 inch, which placing ahead of center will be readily seen to be, in effect, tipping the heel down, or the reverse of the position in the jig at *G*. On our 1½-inch and 2-inch taps we place the cutters slightly behind the center, since if put in on the center the same as in the 1¼-inch tap, there would be too much clearance, when we really want less with the number of cutters remaining the same, which is four.

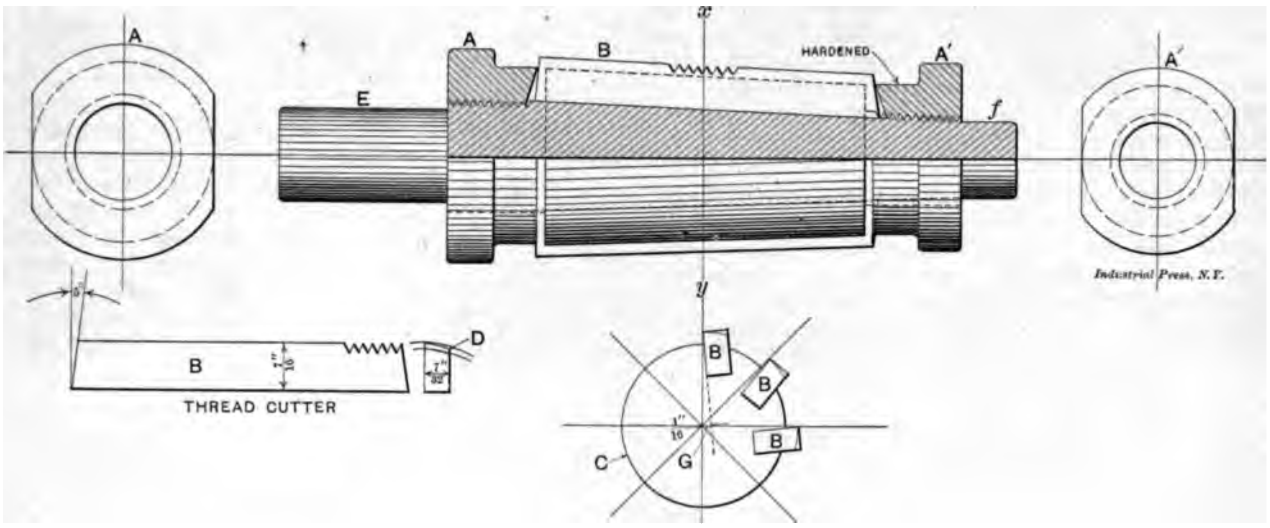
This holder may appear to be very slender, and is, of course, more so at the small end, but we have one in use that has held about 400 sets for cutting, or enough for 800 taps. The end, *E*, is longer than *f*, simply for dogging the holder, being, of course, used on centers.

We use a Reed lathe, with taper attachment and compound slide, and use the Rivett Dock thread tool, finishing a 11½ pitch thread with 13 to 15 cuts, and gaging the size by means

of a set caliper to which the thread is brought to fit at one end. This is a very important feature of this taper work in getting the exact size, as regards the distance to which the tap will enter the work, and especially so in using three-spindle machines for pipe tees, as if the taps go in too far they will come together.

This system of making taps is carried up to sizes as large as 12 inches, some changes in detail being, of course, necessary in the larger sizes. W. J. H.

Providence, R. I.



SECTION AT xy

Jig for Making Thread Cutters.

VALVE GEAR FOR GAS ENGINES.

Editor MACHINERY:

The problem of designing a gasoline engine came to the writer some time ago for solution, in which the engine was to have two cylinders, cranks opposite, hammer-break igniters and adjustable sparks. It was to operate on the four-cycle principle, and run in either direction, not self-reversing,

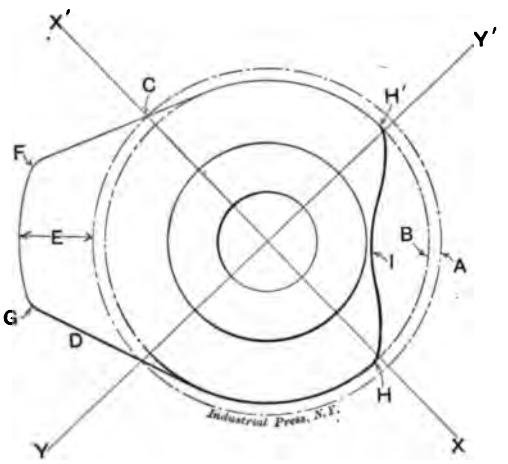


Fig. 1.

but to run in the direction in which it is started. The engine was to be governed by holding the exhaust valves open, on the "hit-and-miss" principle, the igniters being operated from the motion of the exhaust valve push rods, which thus necessitated a special design of valve motion cams.

A novel design of cams was undertaken, which will be described. In the first place, the igniter was arranged to be operated from the valve rod by a finger attached to it which separates the contact points as it moves upward, by lifting up another finger or hammer, and then letting it go, allowing the hammer to hit and separate, the points producing a spark, on the principle of "hammer-break" igniters. In laying out the cams the circle, *B*, was drawn of the diameter of the desired cam, and then another concentric circle, *A*, was drawn slightly larger than the circle, the distance between the two circles representing the "lost motion" travel; that is, the amount of play in the valve push rod and roller. Lines, *X X'* and and *Y Y'*, perpendicular to each other, were then drawn, intersecting each other at the center of the circles. Although it is generally accepted amongst gas engine designers that the proper point for the exhaust to take place is when the piston reaches about nine-tenths of its expansion stroke, still in this case it was necessary to start the exhaust exactly at the end of the stroke on account of the arrangement for the cams to run in either direction, and as it is necessary that the valve should close at the end of the stroke. Therefore, as the lines, *X X'* and *Y Y'*, are taken to divide the circle into four parts to represent the four strokes which constitute the cycle, it is necessary to start at one of them for exhaust to begin at as *C*. Drawing a line through the intersection of the line *X'* and the circle, *A*, and tangent to the working circle, *B*, and another similar line, *D*, gives the eccentric parts of the exhaust projection for both directions. The distance, *E*, equal to the desired lift of the valve was marked off and an arc drawn through that point concentric with the other circles, and then by rounding off the corners where the arc meets the eccentric lines at *F* and *G*, the exhaust portion of the cam was completed. By making the lines, *C* and *D*, tangent with circle, *B*, the easiest possible movement in starting the roller is permitted.

The remaining part of the cam to be laid out was the ignition portion. It is necessary for ignition to take place near the end of the compression stroke either before, or after, or on the dead center according to the compression, speed, etc. The end of the stroke for either direction is at the point *H* or *H'*. The distance from *I* to *B* was laid off equal to the stroke necessary for operating the igniter and the contour of the cam adjusted to take in that depression, the corners *H* and *H'* being rounded past the lines *X* and *Y'* to allow of late ignition if desired. Thus the roller will travel upward from *I* to *H* or *H'* causing the points to come into contact with each

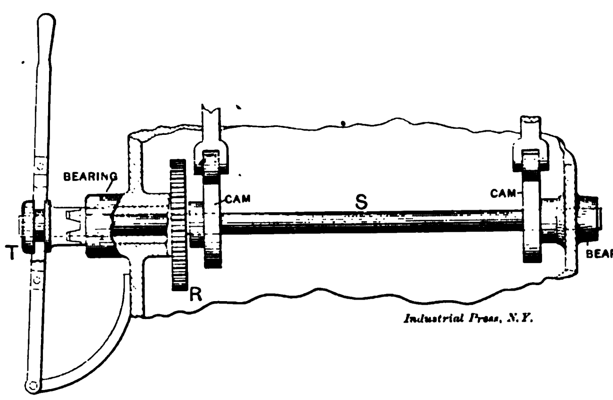


Fig. 2.

other and separate before the roller and rod has reached the highest point. Suction or expansion takes place between *X* and *Y* or *X'* and *Y'*, exhaust between *Y* and *X'* and compression between *X* and *Y'*. It may be seen that this method has the advantage in governing by holding the exhaust valve push rod up, which keeps the igniter out of contact.

In Fig. 2 is shown the method of changing the position of

the cams with relation to the crankshaft by means of a simple clutch. The gear, *R*, is twice the diameter of the driving gear on the crankshaft, as usual, and has a sleeve extension cast solid with it. This gear and sleeve is mounted on the shaft, *S*, running loose on the latter and the end of the sleeve extending out through the bearing has four notches therein to form a clutch. The shaft, *S*, extending through beyond has a clutch or toothed sleeve, *T*, to fit the notches in the gear-sleeve, which clutch slides on the shaft, but is kept from turning by a feather fitted to it and the shaft. By pushing the lever in and causing the teeth of the sleeve, *T*, to engage the notches in the gear-sleeve, the gear will drive the cam shaft, which will cause engine to run in one direction; while by pulling out the clutch and turning the crankshaft one-half turn, or the camshaft one-quarter turn, and then pushing in the clutch again sets the cams for the engine to run in the opposite direction. By pulling the lever out and immediately pushing it in again while the engine is running will cause the clutches to engage on the next set of notches as ignition will simply take place at the outward end of the stroke. The engine was not, however, intended to be self-reversing, but gives satisfaction for what it was designed for.

Oshkosh, Wis. L. J. MONAHAN.

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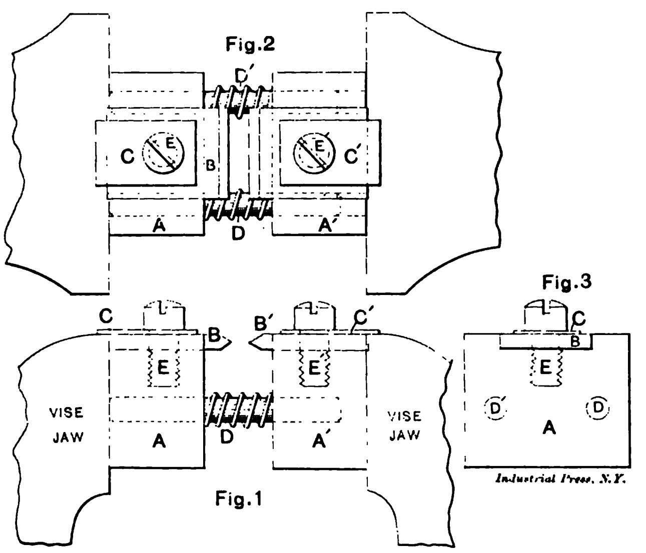
STEEL WIRE CUTTER.

Editor MACHINERY:

The accompanying diagrams illustrate a convenient cutter for cutting up Stubs steel wire or drill rods. Fig. 1 shows it in elevation, and Fig. 2 in plan, Fig. 3 being an end view of the cutter block. It consists of two cast-iron blocks, *A A'*, into which slots are planed on top to receive the steel cutters, *B B'*, which are fastened with the screws *E E'*, as shown, and it is used by placing it between the jaws of a vise and



Cutter for Steel Wires.

closing up the vise when it is desired to cut. The cutters are guided to move in line with each other by two pins, *D D'*, which are driven tightly into the block *A*, and slide freely in holes in the block; *A'*. Two coiled springs hold the cutters apart normally, as shown. The plates of sheet metal, *C C'*, which are held in position by the same screws that hold the cutters, project back beyond the blocks, *A A'*, and serve to support the device when the vise is loosened. The rear end of each cutter should project back slightly beyond the cast-iron blocks so as to relieve the screws from any strain in cutting.

Meriden, Conn. JAMES P. HAYES.

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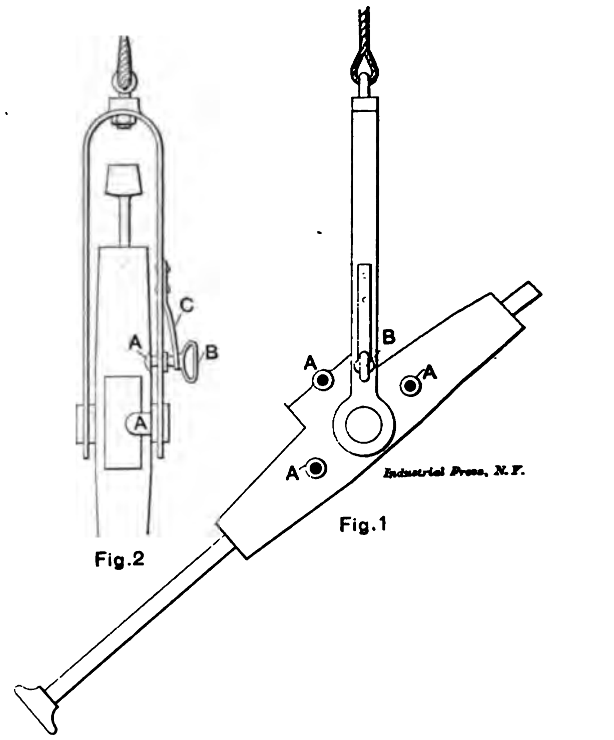
METHOD OF SUPPORTING PNEUMATIC RAMMER.

Editor MACHINERY:

I send you herewith a sketch of a suggested improvement in the pneumatic rammer. The rammer is usually hung by a flexible support with a counterbalance, so as to adjust the height, but while the man is operating it there is no way to prevent its swinging. In one I have seen working the operator had a rope tied about half way up the barrel, which was a disadvantage, as it required one hand to hold the rope in place, causing the operator to partially lose control of the tool.

The idea shown in the sketch will obviate the trouble, I think. Fig. 1 shows a side view of the tool and Fig. 2 an end view. It will be seen that the bosses *A A A* are cast on



the cylinder and valve chest and are drilled for the locking pin *B*. This pin is supported by a flat spring, *C*, that holds it in place and allows it to be withdrawn easily so as to clear any of the bosses, and the tool can then be tilted into a vertical or horizontal position, as desired, and locked by the pin, which will enter the corresponding hole through the action of the spring. WILLIAM F. TORREY.

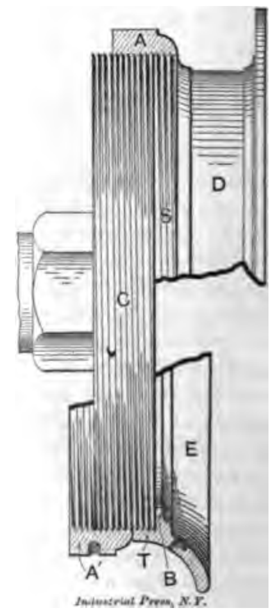
Quincy, Ill.

• • •

COMBINATION CHUCK FOR LARGE RINGS.

Editor MACHINERY:

The accompanying diagram shows a combination chuck for holding work threaded male or female. It is used for turning large metal cases and also flanged rings to fit upon the cases, and is so designed that if the female work fits snugly upon the chuck, and the male work also fits snugly, the two pieces of work will fit snugly together. It consists of a disc, or chuck, *C*, of the finished diameter and number of threads, and a metal ring, *A*, screwing upon the chuck. For holding male work, as in the case, *D*, the chuck ring, *A*, is screwed out till it projects from the chuck and then the externally threaded portion of the case is screwed firmly inside the ring. For female work, as the flanged ring, *E*, to fit on the case, *D*, the chuck ring is screwed back, as at *A'*, and the flanged ring with internal threads is screwed on the chuck as far as its shoulder, *B*, will permit. In turning the flanged rings, the chuck ring is screwed up, or butted, against their back faces, which helps to prevent the inner flange of the ring, *B*, being buckled out by the strain of turning. In this



Combination Chuck.

way the chuck proper is used as a gage for the fitting of the flanged rings while the chuck ring serves for the same purpose

for the cases. This device has also a decided advantage over the ordinary female chuck, as in the ordinary female chuck made solid the case will screw in so tightly that it is a source of trouble to take it out; with the movable chuck ring on this style of chuck the case is very easily removed, as the chuck ring can be "backed off" enough to overcome the locking effect.

J. B. NIEMAND.

Bridgeport, Conn.

* * *

SWAGING COLLARS ON STUDS.

Editor MACHINERY:

The tool to be described came into existence a short time ago, after a very heated argument between the officials of the shop where I was employed, as to whether a collar could be swedged onto a piece of wire by driving from the end without heating. Studs of this kind were a necessity and had been made on a screw machine, proving very expensive. The outcome of the argument was the tool shown in the accompanying diagrams, which proved a success.

In making this tool, a block of soft steel, *A*, Fig. 1, was milled in the shape shown, the two sides and ends being milled bevel, as the work was to be done in a stamp and the poppet-screws would then always have a tendency to

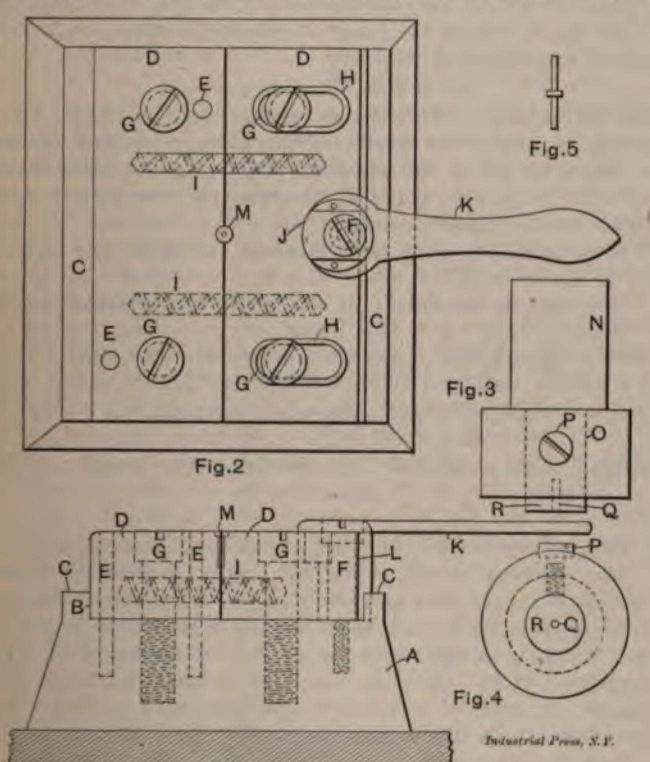


Fig.1

clamp the tool snugly to the anvil of the stamp. After milling the bottom piece or base, a recess was milled in its top, leaving shoulders, *C C*, on each side, which were to form a backing for the dies that were to be fastened in this recess. For the dies *D D* two pieces of tool steel were milled to the shape shown in the drawing and fastened to base with the screws *G*, the stationary side *B* being doweled at *E* besides, and the screw-holes on the movable side being elongated, as at *H*, to allow the moving of that half of the die after the stud should have been swedged. Holes were then drilled in each die, as at *I*, for the springs, which were open spiral springs, and served to open the dies after they had been released. The hole for the cam was then bored of the desired diameter in the movable die at *J*. As the cam was turned to a close fit, it had a bearing on the die and was backed up by the shoulder at the same time, which did a great deal toward relieving the strain on the screw that fastened the cam in place. When the cam was turned, it was drilled eccentrically 3-16 inch off center, for the screw *F*, which would allow the die to open the desired width. The top of the cam was then milled for the handle *K*, which handle was made the shape of an open-ended wrench to fit over the top of the cam, and was fastened on with dowels. The cam, with its handle, was then fastened into place by the screw *F* and the die was ready to be drilled at *M* for the hole for the stud and then counterbored for the collar on the stud. This completed the making of the dies. They were then, together with the cam, hardened.

The plunger was next taken up. A piece of soft steel was turned with a shank *N*, Fig. 4, to fit the hole in the jack die. The hole *O* was drilled in the bottom of this piece and a piece of tool steel, *R*, was turned to fit in it and was fastened in by the set-screw *P*. A hole was then drilled in center of this plug at *Q* of a size equal to that of the wire to be used, and of a depth equal to the desired length of the stud from the collar to the end opposite the one that enters the hole in the die. This plug was then hardened, which completed the making of the tool.

The tool complete was put into a stamp with a 45-pound hammer, and set by clamping a piece of wire of the size to be used in the hole, *M*, in bottom die. Then the top die was placed in the jack and the hammer lowered for adjusting the bottom die until the end of wire projecting from it entered the hole *Q*. The poppet screws were then adjusted until the bottom die was fastened into position, which rendered the tool ready for use. A piece of the wire was cut 3-32 inch longer than the required finished length and clamped into the bottom die. The hammer was then dropped a sharp blow, which drove the ends of the wire into contact with the bottoms of the holes, compressing it and giving it the desired length and also forming the collar in the correct position. The cam was then released by turning handle, *K*, which allowed the dies to open, and the stud was then taken out finished, as shown completed in Fig. 5. This tool reduced the cost of the product to a very small amount as compared to the cost of making on a screw-machine.

"NOTROH."

* * *

THE NEW METHOD OF COMPOUND INDEXING ON THE UNIVERSAL MILLING MACHINE.

Editor MACHINERY:

As my article on the "New Method of Compound Indexing," in July MACHINERY, may have been too technical for some of your readers, I will attempt another explanation. I have been brought to this conclusion by several questions which have been asked me by fellow-workmen. Some who are able to calculate the gears are unable to prove them, or are not quite satisfied with the proof given.

It should be thoroughly understood, however, that the new method does not change the relation between the actual turns of the index crank and the revolution of the work spindle. This ratio is always 40 to 1, no matter which way the index plate is geared to turn, or at what rate in relation to the turns of index crank, as 40 turns of the crank with reference to a fixed point brings the spindle once around. This number, 40, is for ordinary cases, divided by the number of divisions required to get the crank movement. For example: Required the crank to move for 80 divisions; 40-80 equals ½, and a half-turn of the crank would give 1-80 of a revolution of the work spindle. Now, if the index plate is geared to the work spindle so as to turn with it, the number of crank turns around the index plate from a given point on the plate will be varied, being either more or less than 40, according as to whether the plate moves in the same direction as the crank or opposite to it. The number of turns of the crank with reference to the index plate which cause one revolution of the work spindle may be divided by the required number of divisions, in order to obtain the crank moves, the same as when the plate is anchored; but when the index plate moves we get the apparent turns of crank, and not the actual turns. By varying the crank turns necessary to produce one revolution of the spindle, many odd divisions can be obtained more easily than by any other method.

To make the explanation clear in regard to the crank turns, let us use for an illustration the hands of a watch: The long hand corresponds to the crank and the short hand to the index plate. Whenever the hands meet may be compared to a revolution of the crank around the index plate. Suppose the hands are together, as at 12 o'clock; how often will they meet during one complete revolution of the short hand, or in 12 hours or revolutions of the long hand?

A little consideration will show why they come together 11 times. The short hand makes one revolution while the long hand makes 12, and therefore one revolution must be subtracted from 12 to get the number of times the hands meet. Suppose there is placed an idler gear in the watch to cause the short hand to move in an opposite direction to the long hand: How often would the hands meet during 12 hours, or revolutions, of the long hand? A little consideration will show that they will meet 13 times. As the short hand makes one revolution in an opposite direction during 12 revolutions of the long hand, one must be added to 12 to get the number of times the hands meet. The same reasoning may be applied to the turns of crank, when the index plate is geared to the spindle. Suppose equal gears are used, and one idler, so that the index plate moves in the same direction as the index crank: Then one must be subtracted from 40 to get the number of times the crank meets the same hole in the index plate, which is 39. If two idlers are used, so that the plate rotates in the opposite direction from the crank, or in a direction opposite the hands of a watch, one must be added to 40 to get the number of times the crank meets the same hole in the plate, which is 41.

The above reasoning will probably be found sufficient. But, for those who are familiar with algebra, the following may be interesting: With equal gears on the spindle and plate, let x equal the turns of the crank from the starting point, until it meets the same hole in the index plate; then $\frac{x}{40}$ = movement of the index plate.

$$\text{Then } x = 1 \text{ turn} + \frac{x}{40};$$

clearing of fractions: $40x = 40 \text{ turns} + x$;

$$39x = 40 \text{ turns, whence}$$
$$x = \tfrac{40}{39} = 1\tfrac{1}{39} \text{ turns.}$$

Thus the crank would meet the same hole in plate at 1 1-39 turns. Now, as 40 turns bring the spindle around once, there would be $40 \div 1\,1\text{-}39 = 39$ divisions. With the same gearing ratio of 1 to 1, and two idlers in use,

$$x + \frac{x}{40} = 1 \text{ turn (actual, } x = \text{apparent)};$$

clearing of fractions: $40x + x = 40$ turns (actual):

$$41x = 40 \text{ turns, whence}$$
$$x = \tfrac{40}{41} \text{ turns.}$$

Then the crank pin meets the same hole in the plate at the 40-41 part of a turn.

$$40 \div \tfrac{40}{41} = 40 \times \tfrac{41}{40} = 41 \text{ divisions.}$$

Now these numbers, 39 and 41, can be used for index reckoning numbers to obtain the crank moves for a number of other divisions. Taking 39 for the index number, divide it by any number, and if the quotient, or ratio, can be found among the index circles, that number can be indexed.

For 3 divisions, $\frac{39}{3} = 13$ turns of crank; for 13 divisions, $\frac{39}{13} = 3$ turns of crank; for 57 divisions, $\frac{39}{57} = \frac{13}{19}$ turns of crank, using the 19 hole circle; for 63 divisions, $\frac{39}{63} = \frac{13}{21}$ turns of crank. A number of other divisions also can be obtained. With 41 for the index number, for 123 divisions, $\frac{41}{123} = \frac{1}{3}$ turns of crank, and for 246 divisions, $\frac{41}{246} = \frac{1}{6}$ turns of crank.

Now, if the gearing ratio is 2 to 1, or if a gear with twice as many teeth on the plate as on the gear is placed on the spindle, with one idler, there would be 38 turns of the crank to bring the work spindle once around. If two idlers are used, 42 turns of crank would be required. The same reasoning as given above can be applied to this case; as the ratio is 2 to 1, the plate moves 2-40, or 1-20, as fast as the crank.

Algebraic proof for one idler:

x = turns of crank, for 1 revolution around plate;

$\frac{x}{20}$ = moves of plate;

$$x = 1 + \frac{x}{20};$$

clearing of fractions: $20x = 20 + x$,

$$19x = 20;$$
$$x = \tfrac{20}{19} = 1\tfrac{1}{19} \text{ turns.}$$

Then, $40 \div 1\frac{1}{19} = 38$ = index reckoning number.

With two idlers: $x + \frac{x}{20} = 1$ complete turn of crank;

clearing of fractions, $20x + x = 20$ turns of crank;

$$21x = 20;$$
$$x = \tfrac{20}{21} \text{ turn of crank.}$$

Then, $40 \div \frac{20}{21} = 40 \times \frac{21}{20} = 42$ = index reckoning number.

For indexing prime numbers, the index reckoning number must be a fractional one. Suppose it is required to obtain 61 divisions: We can obtain a vulgar fraction so that 61 may be contained in the numerator, for an index reckoning number; thus, $2 \times 61 = 122$. Now divide this by any number, say 3, so that the index number will be near 40; thus, $122 \div 3 = 40\,2\text{-}3$. As this number is greater than 40, two idlers will be required, so as to rotate the plate opposite to the crank, 2-3 of a turn, during 40 actual turns of the crank with reference to a fixed point; that is, the index crank would meet the same hole in plate 40 2-3 times during 40 actual turns of crank, or one revolution of the work spindle. And gears in the ratio of 2-3, or 32-48, or 48-72, are required, either of which pairs of gears would do—the numerator, or gear, above the line, on the spindle, and the denominator on the plate.

Now, to obtain the apparent crank moves, as in the previous cases, divide the index reckoning number by the required number of divisions:

$$\tfrac{122}{3} \div 61 = \tfrac{122}{3} \times \tfrac{1}{61} = \tfrac{2}{3} = \tfrac{26}{39}$$

and 26 divisions (27 holes in sector) on the 39-hole circle would be used. The proof for the index reckoning number is the same as in the previous cases. As the plate moves 2-3 of a turn in an opposite direction, the crank must make 40 2-3 turns. Algebraic proof:

x = turns of the crank until it meets the same hole in plate again.

The rate of movement of the plate with relation to the crank $= \frac{\frac{2}{3}}{40}$ or $\frac{2}{3} \div 40 = \frac{1}{60}$ then $\frac{x}{60}$ = moves of the plate.

$$x + \frac{x}{60} = 1 \text{ complete turn of the crank};$$

clearing of fractions: $60x + x = 60$ turns of the crank;

$$61x = 60;$$
$$x = \tfrac{60}{61}$$

Then $40 \div \frac{60}{61} = 40 \times \frac{61}{60} = 40\frac{2}{3}$ = index reckoning number.

The algebraic proof, while not really necessary, is convenient to use, serving as a check on the calculations. Algebra is a valuable study, and one which, if a mechanic learns, he will be likely to find a use for, as it is of assistance in using formulas which occur so much in mechanical books and papers. It may be self-taught, although with a teacher the progress will be likely to be more rapid.

East Providence, R. I. J. T. Giddings.

* * *

TOOL ROOMS.

Editor Machinery:

While much has been written upon machine shop methods and arrangements, there is very little in current literature upon the subject of tool rooms. This is due, in part, probably to the fact that the needs of different shops vary so greatly, and in part to the complex nature of the subject itself. In what follows I would like to present the general features of the problem as they appear to me.

The tool room should have its delivery window as near as possible to the center of shop patronage, as a matter of course, and this window in turn should be as near as practical to the center of the tool room itself.

While there should be no congestion of workmen or boy carriers a gas pipe railing should be swung as indicated in front of the window, so that approach must be in single file and in a common direction, as indicated by the arrow. This avoids "scrapping" over "turns," and promotes a prompt and systematic disposition of each applicant.

The window and shelf should always be wide enough for two, and an understudy or second should be on hand to help out when things are running in bunches.

With grinding drills, oiling tools, sorting material, etc., there is always plenty of work in the average tool room

for a bright boy, and in case of sickness or unavoidable absence of the toolkeeper it is of the greatest importance to have someone on hand familiar with the location of the tools.

It is also self-evident that tools should be grouped around the window in relation to demand, those called for most frequently being nearest. Almost any bright toolkeeper if left to himself will develop this arrangement, as it lightens his labors and follows the line of least resistance.

A tab on the number of times each tool is taken out during a given week would furnish a fair basis for the arrangement. In general we should have an arrangement something like the following, moving back from the window:

TOOLS.	
Drills, standard,	Straight edges,
Taps and wrenches,	Scales,
Dies,	Jacks,
Mandrels,	Snipes,
Rosebits,	Belt punches,
Reamers,	Special drills,
Broaches, counterbores,	Special taps,
Dogs,	Special reamers,
Files and handles,	Jigs, etc., etc.
Snap gages,	MATERIAL.
C. clamps,	Oil,
Micrometers,	Waste,
Pipe taps and wrenches,	Cord,
Pipe dies and stocks,	Chalk,
Squares,	Set and cap screws,
	Stubs steel wire, etc., etc.

For most of these small tools an angle iron framework should be made as indicated in Fig. 2. This will carry ash shelves 15 inches by 30 inches inclined at an angle of 30 degrees and gouged out to fit particular tools. Having no back it does not intercept the light, and the inclination throws the shelf at right angles to eye's line of vision as nearly as practical and in a favorable position for removing and returning tools quickly.

Checks should be ⅞ inch round with a ¼ inch hole stamped both sides. Pins for them should be straight and incline back about 30 degrees to the shoulder, so that checks will slide back and not readily fall off. For small drills and taps shelves should be drilled so that the tool projects at right angles. Stock may be kept on the top shelf or near the floor, as these extremes are not convenient for regular delivery.

Stocks and large wrenches may stand on end in a rack slightly inclined backward or be laid across pipe supports above the head.

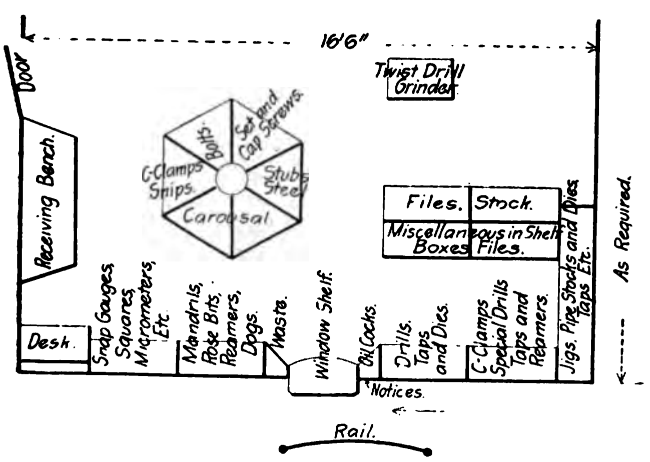


Fig. 1. Arrangement of Tool Room.

Commercial galvanized iron shelf boxes about 6 x 6 x 12 inches will be found convenient repositories for a great variety of special and miscellaneous supplies. Anybody who notes the gain in neatness where these are used in the modern hardware store will appreciate their applicability to much of the shop's small hardware.

Waste should be kept under the delivery window on one side. Oil for squirt cans should be in a tank near the ceiling and be piped to a cock at one side of the window with drip-pan underneath.

The "carousal", or merry-go-round (Fig. 1) has great capacity, being four and a half feet in diameter and seven high. It should be framed of steel and mounted on ball bearings, with a foot brake for stopping quickly, leaving the toolkeeper's hands free to seize the required tool. It will be noted that the general arrangement puts the toolkeeper's desk equi-distant between window and door, with a receiving bench behind him.

The twist-drill grinder, power back saw, rod stock, etc., are near the rear of room.

Stubbs' steel drill and Bessemer rod may be kept in good shape in a honeycomb arrangement of ordinary iron pipe running from 1¼ inches to 1½ inches in size and about 18 inches long.

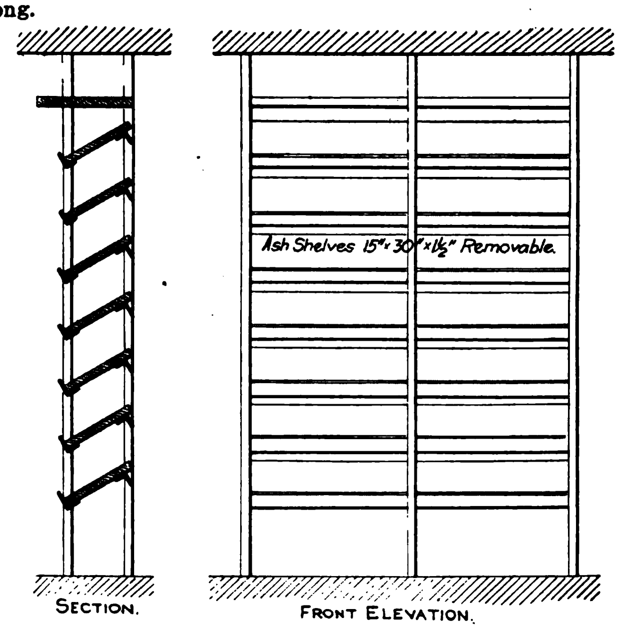


Fig. 2. Tool Rack.

The exact arrangement must be left to the individual toolkeeper and the particular stock, but experience has demonstrated that within this area of a hundred square feet we have considered may be kept a complete complement of tools for the largest shop that could advantageously draw from one point. With the arrangement shown the average walk is cut to little more than three feet, or two steps each way.

When we find an average of two persons waiting, as is often the case, at the tool-room, while the keeper is sauntering off to remote corners for common tools spread out at random, the saving that can be effected here is apparent.

ELMER E. WARNER.

* * *

There are a great many hollow metal balls used in water columns and safety devices of various kinds in connection with steam apparatus, and these often give way at the higher pressure now common. Various methods have been adopted for strengthening them internally against this crumpling action of the steam. Some people have used a light metal framework to hold out the sides, but this increases the weight of the ball and therefore destroys to just that extent the buoyancy of the float. Others adopt a simpler plan and introduce a small quantity of water into the interior and when the float is heated from the surrounding water the water on the inside of the float in its turn commences to heat up and give off steam. There will then be an internal pressure to resist the external one, and this will tend, of course, as long as the ball does not leak, to keep the thing in shape and in good working order. I found in a shop down East still another way of getting at this, though on lines somewhat similar to the last method. It consisted in substituting naphtha or gasolene for the water inside the ball. After the ball was closed by the supporting rod, which also acted as a plug, the ball was held over a gas jet and heated. Now if there was any leak it would immediately light up; even the sense of smell might detect it, and this was in that way preferable to the water.—F. O. Reman, in *Iron Trade Review*.

* * *

Recent tests have demonstrated that the simultaneous firing of several heavy guns is heard 140 miles, and that at a distance of 84 miles the reports were so perceptible as to attract attention of people in country districts. At a distance of 61 miles the detonations were so heavy as to jar windows in a manner ordinarily associated with comparatively nearby explosions.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

LATHE FACE-PLATE DRIVER.

O. A. Reich, Mattoon, Ill., has had to turn quite a number of counterbalanced crankshafts, the counterbalances, of course, making one side heavier than the other when turning them in the lathe. Unless the crankshafts are withheld, they fall

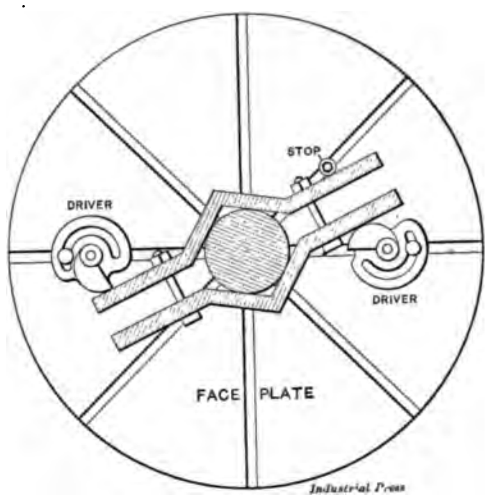


Fig. 1.

forward away from the driver at each half-revolution, which must be prevented. A stop is bolted on the faceplate, and two drivers used in connection therewith which are readily

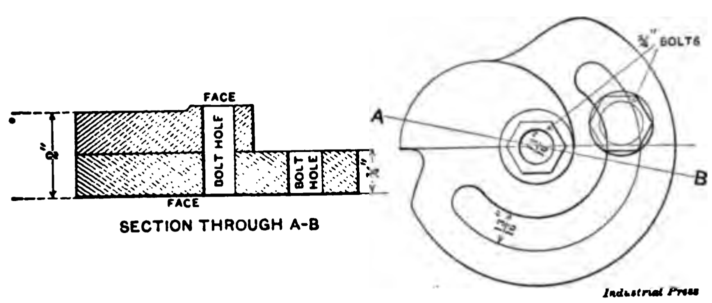


Fig. 2.

adjustable so as to divide the turning moment equally between both arms of the clamp on the crankshaft. Fig. 1 shows the drivers in position, and Fig. 2 shows how they are made. The idea is so obvious that no more explanation is necessary.

TRANSFORMING ORDINARY CALIPERS INTO TRANSFER CALIPERS.

E. E. Cook, Salem, Ohio, sends sketches of a small lathe job which required a transfer caliper for measuring the internal diameter, and the device which was made to allow an ordinary caliper to be used as an inside caliper. The piece shown in Fig. 3 required boring out, and of course a transfer

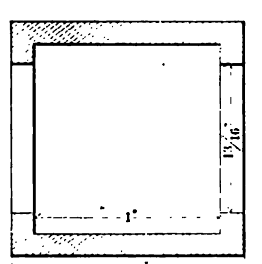


Fig. 3.

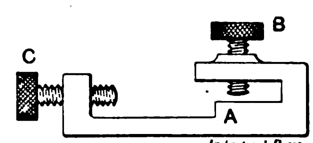


Fig. 4.

caliper was needed to take the size. The old expedient of setting the calipers and then scratching a line alongside of one of the legs to reset them by when removed, was rejected as inaccurate and unsatisfactory when one desires to keep his tools free from scratches. So the device shown in Fig. 4 was hastily made for the purpose. It consists of the frame, *A*, which is held to one caliper leg by the setscrew, *B*. The screw, *C*, is used as a gage, being screwed up to the other leg when the setting has been obtained and employed as a stop when the legs are opened. The device can be used on both inside and outside calipers.

RIG FOR FILING DIES.

J. E. H., Franklin Falls, N. H., sends a sketch of a device which is marked "diemaker's friend," but which is unaccompanied by any description. The cut, however, shows its use so apparently that little explanation is necessary. It is a filing attachment for the lathe for rapidity and accuracy in filing out the interior of dies. The vertical slide to which the file is attached is reciprocated by a crank held in the lathe chuck. From the cut it is apparent that no connecting rod is provided for the slide, so the latter must have a "Scotch" yoke to compensate for the side movement of the crank. The feet of the frame are arranged to set on the lathe bed, and suitable clamps are provided for holding it firmly in position. The work is held on a tilting table.

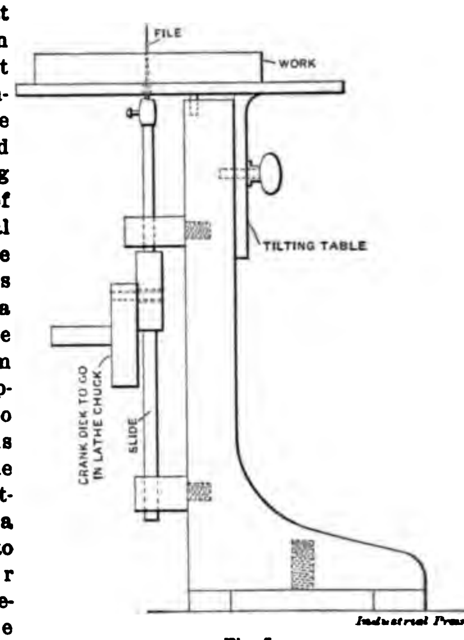


Fig. 5.

REBORING THREADED CYLINDERS.

I. B. Niemand says: "We had a large number of cylinders that we wished to lighten by reboring, but their length, thinness of walls, and the fact that they were threaded on both ends, precluded our doing the work by the ordinary methods, and so we rigged up the device as shown.

"*A* is a cylinder which sungly fits over the outside of the threaded cylinder and screws into the faceplate chuck, *B*. *C* is a locking ring threaded to screw on to the threaded cylin-

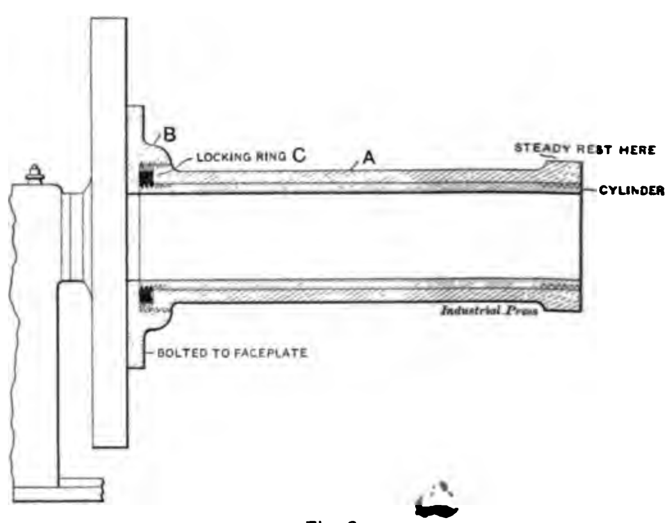


Fig. 6.

ders which require turning, and, being held fast between the faces of *A* and *B*, serves as a check nut on the threaded cylinders, which in turn butts up against the face of *B*. The cylinder is consequently held true in the long sleeve, and is prevented from turning by the locking arrangement. The outer end of the sleeve is held in a steady rest.

"We bored between 200 and 300 of these cylinders, and found this device satisfactory."

MISCELLANEOUS KINKS.

"Phos Phorus" sends a kink that he has found very valuable for successfully hardening the heads of cap-screws. He has been troubled, after hardening cap-screw heads to wear under the wrench, with their snapping off on very slight provocation. But he found that, by hardening the heads for about one-eighth inch down from the top of the head only, the trouble is overcome and the heads wear fully as well.

R. W. states that in his work there are a number of hardened pieces to grind which are so large and heavy that they cannot be swung in a universal grinding machine. A very handy and easily-applied device for this grinding was devised by attaching a small dental motor with a surfacing wheel to the cross-feed of the lathe in which the work was swung, and then by setting the motor and grinding wheel at different angles almost any kind of surface work could be ground. For inside grinding, the motor is placed upon a stand at the back about the height of the lathe and its surfacing wheel replaced by a 7-inch pulley with a belt attachment to a grinding spindle held in the tool post. With this arrangement different kinds of internal grinding can be done rapidly and quickly.

A. E. Phillips, Rockford, Ill., describes a punch for cutting oil grooves in the centers of centered lathe work to prevent cutting the centers because of lack of lubrication. It is made from an old three-cornered file ground to a point, as shown.

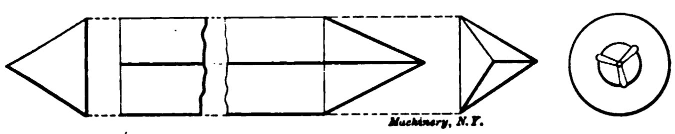


Fig. 7

The temper is drawn down to the blue. By its use the life of lathe centers will be greatly lengthened, especially on heavy work, as they can always be kept lubricated through the three oil-grooves formed by driving it into the center after reaming.

while operated on by the tool, the same as on the shaper. The range and accuracy of the tool equal those of the planer without the disadvantage of being obliged to reciprocate the work. For this reason it has been found to be particularly adapted to stationary engine building shops for machining large engine frames, etc.

In the first models of this tool the ram carrying the tool slide was operated by a longitudinal screw, the driving and reversing pulleys being mounted directly on it. A recent

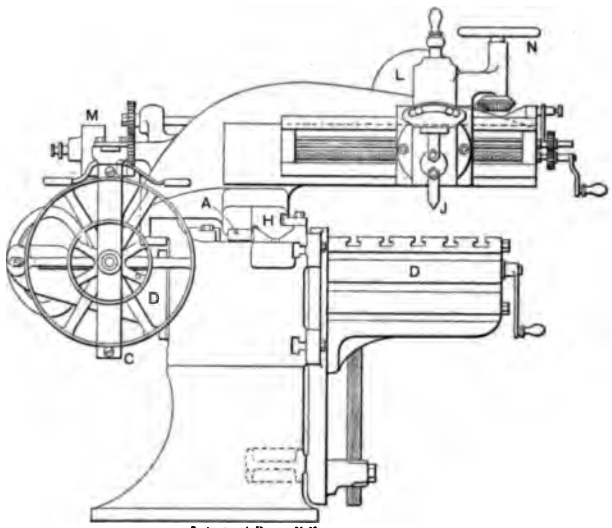


Fig. 2. End View of Richards Planer.

improvement in the design of the driving mechanism does away with the screw and substitutes for it a worm working in a rack the same as the Sellers planer drive. The plan of the machine in the annexed cut shows the arrangement clearly. The rack *A* is attached to the long ram slide *H* and is engaged by the worm *B*. The shaft carrying the worm is driven by bevel gears at *E* from the shaft carrying the driving and reversing pulley *D* and *C*. The rack *G* operates

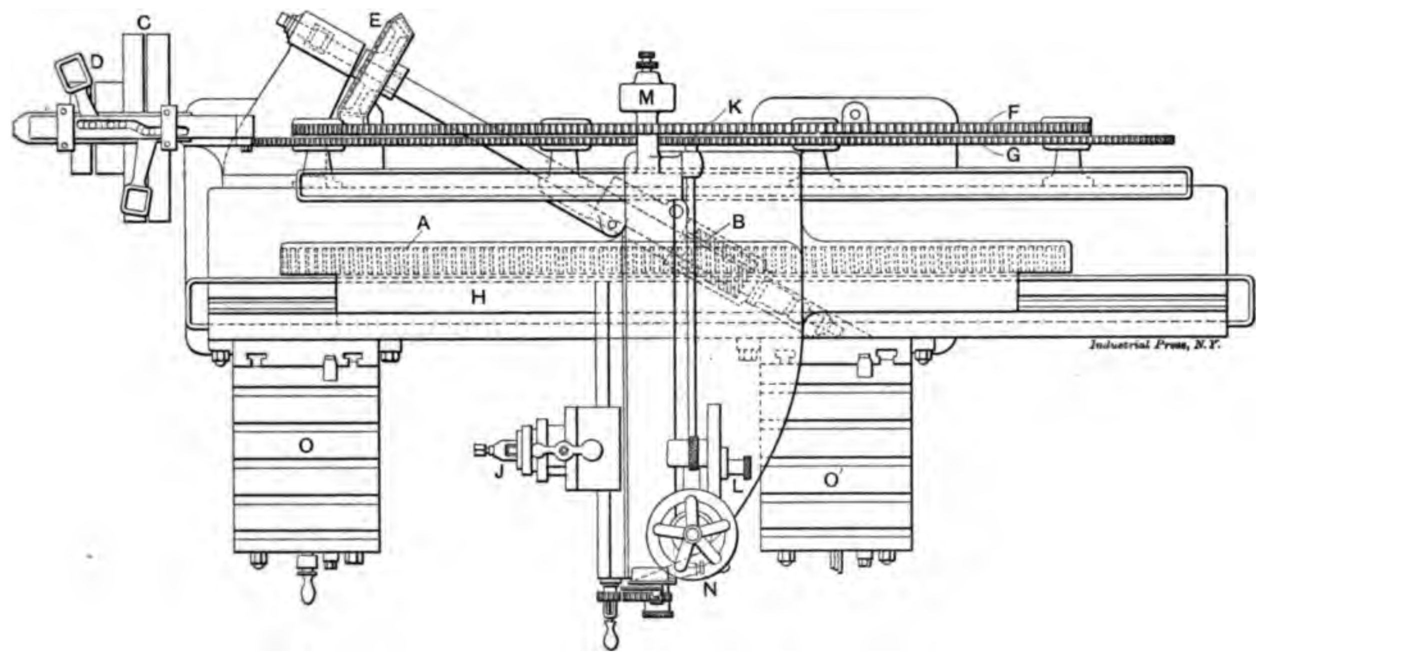


Fig. 1. Plan View of Richards Planer.

IMPROVEMENTS IN THE RICHARDS SIDE PLANER.

A machine tool which is not as well known in the United States as it should be is the Richards side planer. It is a tool against which there appears to be a great deal of unfounded prejudice, since wherever it has been adopted it has generally become an almost indispensable addition to the tool equipment because of its range and adaptability. It occupies an intermediate position between the planer and shaper, having most of the advantages of each, with few or none of their disadvantages. The work remains stationary

the reversing belt fingers by the arresting of the movement of the pinion *K*. This pinion normally rolls in the rack, but when the ram reaches the end of its prescribed travel stops on the disc *L* prevent its turning further, and therefore the rack is carried along with the pinion far enough to reverse the direction of motion. The function of the rack *F* is to feed the tool on the cross slide by means a suitable friction box at M. The operator controls the m ment of the ram at intermediate positions in its trav the handwheel N. O and O' are the work tables, wh provided with suitable elevating screws.

A RAPID GEAR CHANGING ATTACHMENT FOR AN ENGINE LATHE.

The novelty of a gear arrangement upon an engine lathe whereby any one of its change gears may be substituted for any other upon the lead screw without unscrewing binding nuts, handling gear wheels, etc., cannot fail to be of interest. The engravings, Figs. 1 and 2, present the front and head-stock end views of a lathe so arranged, the gear changing attachment of which involves some very interesting features.

The gear changing attachment consists of a gear box in which all the change gears are mounted, and means whereby the gear box may be readily adjusted so as to bring any desired gear into connection with the lead screw, the intermediate and head-stock spindle gears being the same as in ordinary lathe practice. The gear case, which is shown at *A*, Figs. 1, 2 and 3, is a cast-iron box, the cover of which is capable of rotating about a stud *S*, Fig. 3, at its center, and upon the inner side of which cover the change gears are permanently located. These gears have extension hubs which are fitted into bearings in the case, to allow rotation of the gears, and are held in position in their bearings by the collars *B* on the opposite side of the case. The holes shown in the protruding extension hubs, as at *B*, Fig. 2, are the holes passing through the gear hubs. These bearings in the gear case are so placed that the holes are on a circle concentric with the case, which circle is in line with the center of the lead screw, so that any of the gears may be placed opposite the end of the lead screw by simply revolving the gear case cover.

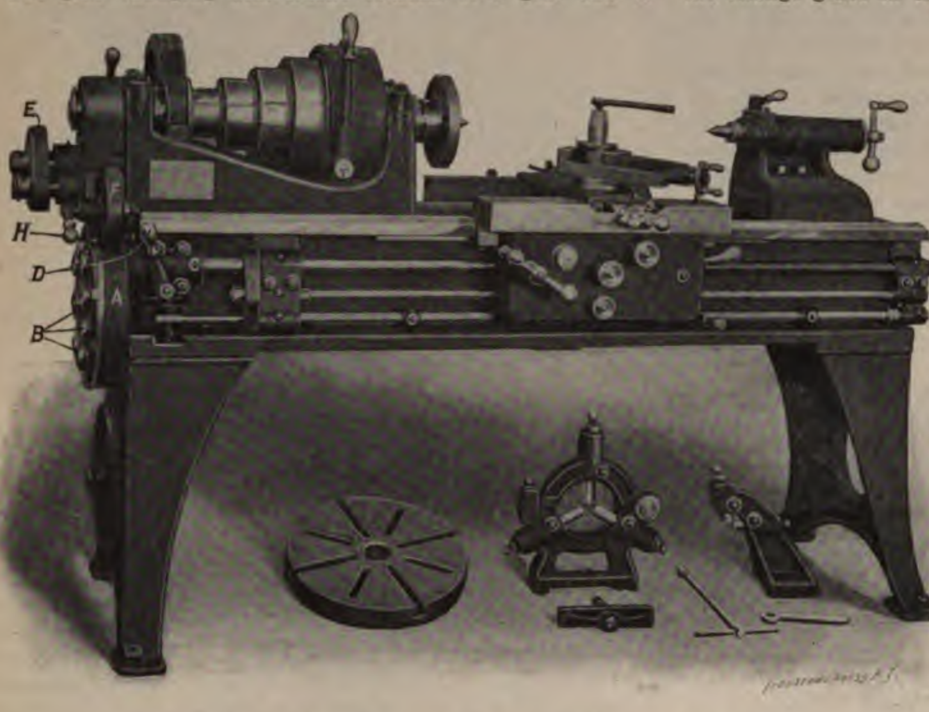


Fig. 1 New Engine Lathe of the Springfield Machine Tool Co.

For connecting any change gear to the lead screw, a clutching device *C*, Fig. 1, is provided, which consists of a telescopically arranged extension of the lead screw shaft. This extension *F*, Fig. 3, which is moved by lever *D*, is reduced at its end to enter the hole in the change gear, a distance equal to its width, before the clutches with which the change gears and the extension are fitted, come in contact with each other. Thus, when one of the change gears is connected with the lead screw, it ceases to depend on the disc for support, but is mounted on the lead screw as substantially as if secured to same by nut and washer. To connect a gear upon the lead screw it is simply necessary to adjust that gear by revolving the gear case until the hole in its hub comes in line with lead screw and then throw the clutch handle to move the extension out to lock with the gear. For ease of adjusting the gear in front of the lead screw a line is cut on the gear case cover which corresponds with each gear, so that by moving the cover until the desired line coincides with a reference mark on the case, that gear is in line with the clutch ready to be locked. By the mounting of the change gears upon the inside of the gear case an efficient guard is provided to protect the gears from dirt or injury, all the eight gears being concealed except at the top where the intermediate gear *F*, Figs. 1 and 2, meshes with them.

Since a sufficient range of feeds, or screw pitches cannot be obtained by changing gears on the lead screw only, a set of three pairs of gears are provided for attachment at the head-stock to vary the speed of the intermediate gear. These pairs of gears, one of which is shown at *E*, are each arranged in small gear cases in a manner similar to the arrangement of the change gears in the case, and are attached and clutched to their spindles by simply slipping them on until their clutches engage the spindles having reduced-end-section clutches similar to the lead screw. These pairs of gears afford the following speed ratios: 1 to 1, 2 to 1, 4 to 1, and, when the latter two are reversed, 1 to 2 and 1 to 4, thus giving five different speeds to the fixed pinion which meshes with the intermediate gear. The arrangement of these pairs of gears in individual cases makes them very handy for placing in gear or removing, and space for those not in use is afforded in the locker *L*, Fig. 2. The intermediate gear, which revolves on a fixed stud on the quadrant to which the handle *H* is affixed, is removed from mesh with the change gears before changing them, by lifting the quadrant. The quadrant has a projection on its lower side, which is machined to the pitch radius of the intermediate gear, and as the same provision is made on the gear case for each of its gears, it is only necessary to drop the intermediate gear until these surfaces meet, and then secure same with clamp lever when the desired gear is clutched in position on the lead screw.

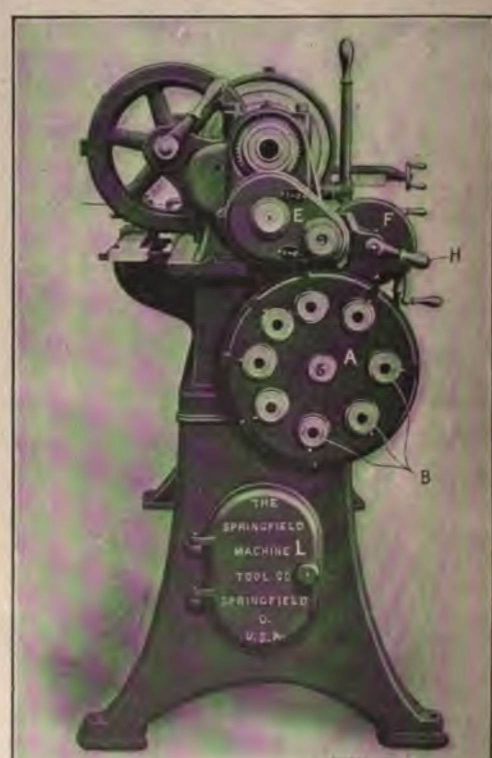


Fig. 2. End View of Lathe.

The range of threads that can be cut on this lathe is from 2 to 56 per inch, and a turning feed from 8 to 224 turns per inch. Every change required to cut any of the threads or

feeds between the extreme limits can be made while the lathe is in motion.

This lathe is made by the Springfield Machine Tool Co., Springfield, Ohio. Besides this novel gear changing attachment, it has several other distinctive features. It has a reverse motion operated at the carriage, an automatic stop for

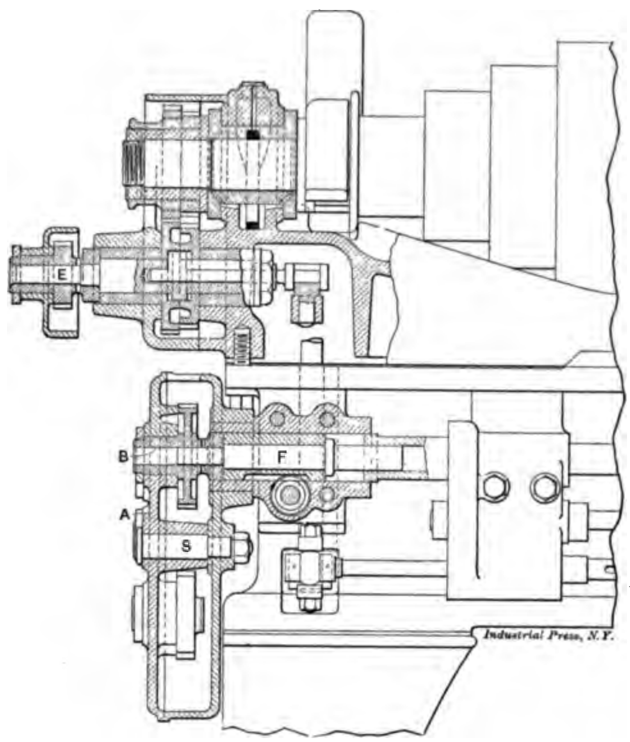


Fig. 3. Detail of Change Gear Mechanism.

turning and screw cutting, and a friction geared head spindle. The friction spindle gearing is similar to that which has proved so indispensable on turret lathes, and adds as many advantages to the lathe.

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COURSE OF STUDY IN SHOP PRACTICE.

It is not frequently the case that we make specific recommendations in our reading columns concerning the purchase of any commodity which is on the market and for sale at a profit. We are quite willing, however, to make an exception in the case of the course of study in machine shop practice that has just been prepared by the International Correspondence Schools, Scranton, Pa., and which is now ready for the enrollment of students. This course of study is a commodity in the sense that it is for sale, presumably at a profit, but it none the less meets with our heartiest approval.

The complete course includes instruction in general machine shop work, and in addition tool making, pattern making, forging and foundry work. Instruction in any one of these departments may be had, or in all of them, as desired by the student.

We have examined the papers that make up the complete course and believe them to contain the best and most complete treatment of shopwork that has appeared. The papers are issued in a large number of sections of perhaps 40 pages each, and these, when bound in book form, as supplied to the students, make four large volumes with contents as follows:

Vol. 1.—As much arithmetic as is necessary to understand the subjects of the course; a paper on reading working drawings; one on measuring instruments, and five papers on lathe work.

Vol. 2.—Papers on working chilled iron; planer, shaper and slotter work; drilling and boring; milling machine work; gear cutting.

Vol. 3.—Papers on grinding; bench, vise and floor work; hints on shop practice; tool-making in six papers.

Vol. 4.—Patternmaking in four papers; foundry work in six papers; blacksmithing in four papers, including soldering, brazing, etc.

We are informed that in the preparation of these papers, including revision, etc., no less than 60 people have been engaged, of whom 20 are specialists in their respective lines. The papers explain methods of doing work, make clear all machine shop calculations likely to arise, and contain descriptions of many labor-saving devices, methods, etc., of great utility. The illustrations are numerous and were made especially for this course. They are in the same style that has been used by the International Correspondence Schools from the first; that is, they are pen and ink drawings, most of them in perspective, and are superior to any similar illustrations with which we are familiar. There are also many useful reference tables.

It is our impression, in looking over these papers, that here is a favorable opportunity for mechanics, and especially young mechanics. We have expressed ourselves in another part of this month's number as believers in skilled and well-informed mechanics. We believe the chance for the employment and advancement of such is so good that it will pay a mechanic to try to become a skilled and well-informed workman, and also that such a one is the kind that it pays manufacturers to employ. It is a considerable problem for any mechanic, however, to know how to become a skilled workman. Formerly an apprentice was bound out and had the opportunity to learn all branches of his trade. Then he became a "journeyman"; that is, he journeyed from one town to another, working in different shops and picking up valuable information. To-day there are several times as many subjects to be mastered before one can become an "all-around" machinist, as was required a few years ago, and unfortunately few apprentices have as good a chance as formerly to master even the few things that were supposed to make up a machinist's store of knowledge in times past. The tendency is towards specialization and too often a man is kept on one or a few lines of work until he becomes virtually a part of the machine on which he is employed.

Take the case of a milling machine hand. Often a man will work for years on a milling machine without understanding what the machine can actually accomplish, and without knowing how to make the calculations for spirals or for indexing. He may not even understand how to set the machine for any except the jobs with which he is familiar, this work being done by the foreman in charge. Much less, also, will the milling machine hand understand about other work. He may know nothing about grinding machinery, toolmaking and tempering, and the set-up for chucking and screw machines; the erection of machinery and many other lines of work will be unknown quantities to him.

What hope is there of such a one pushing ahead to a position of greater responsibility? His only hope is to find out about these various subjects, somehow or somewhere, and make himself master of them. It is for this reason we say that in a course of study like the shop course offered by the International Correspondence Schools is an opportunity for mechanics. A machinist is primarily a hand operator. He must become skillful with his hands and be able to do fine or rough work, as the case demands, within a reasonable length of time, and this much can be acquired by any careful and diligent man or boy. Beyond this, however, the machinist, if he is to advance, must become a mind worker. He must know about things, he must be a student of shop operations, an observer, and we believe we are not wrong in advising that he become a student in a good correspondence course.

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On July 7, William W. Tucker, of the firm of W. W. & C. F. Tucker, Hartford, Conn., died at his home in that city. He was born in New Britain in 1838, and at the age of 19 became superintendent in a shop at Brookfield, Mass. He was afterwards employed by Cottrell & Babcock, now C. B. Cottrell Sons. Later he entered the employ of the Pratt & Whitney Co., of Hartford, and remained with that company about thirty-seven years. He then went in business for himself. He was the inventor and patentee of many parts of automatic screw machines, some of which he assigned to the Pratt & Whitney Co.; and he received from them for a number of years royalties on many of his inventions. Mr. Tucker was also the inventor of several labor-saving devices for use in bicycle machinery.

MILLING MACHINE FEED MECHANISM.

In our description of the Pan-American Exposition, published in the July number of MACHINERY, reference was made to the positive feed mechanism of the milling machines exhibited by the Cincinnati Milling Machine Co., Cincinnati, O., and it was stated that we should publish a description of the device in a future number.

The features incorporated in this mechanism are:

a—A positive gear-driven feed.

b—A great range of feed changes.

c—A means for changing from any one rate of feed to any other rate of feed conveniently and without stopping the machine.

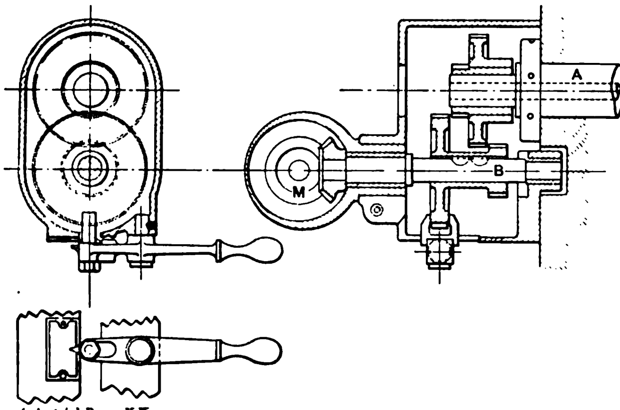


Fig. 1. Mechanism at end of Spindle.

Part of the feed mechanism is placed at the rear end of the milling machine spindle and part is encased in a feed box at the rear of the column. The connection between these two parts of the mechanism is by means of a vertically inclined shaft.

Fig. 1 shows the mechanism at the end of the spindle, *A* being the spindle. Motion is transmitted to shaft *B* by sliding the gears on *B* so as to bring either one of them into mesh with the proper gear on *A*; or the gears may be set in the intermediate position shown in the sketch, in which case no motion is imparted to *B*. This position of the gears throws out the entire feed mechanism. The shaft *B* drives

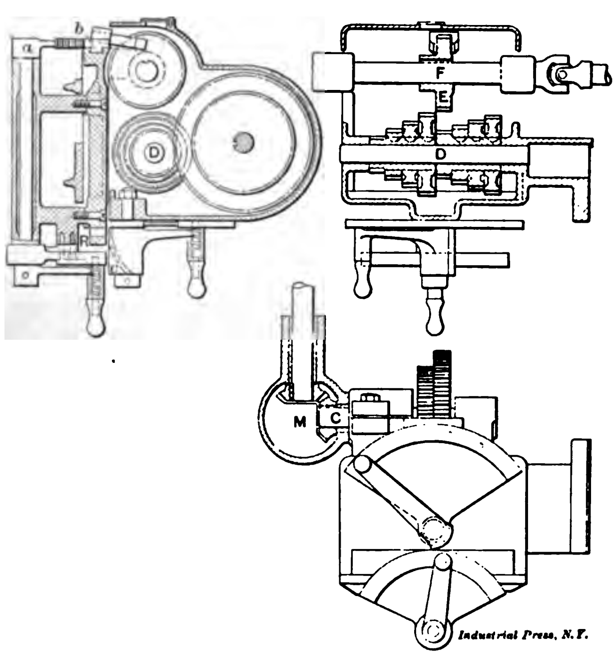


Fig. 2. Feed Cones at Rear of Column.

the shaft *M*, which passes down at an angle and drives the horizontal shaft *C*, which has two spur gears, as shown in Fig. 2. The mitre gears on *M* are of steel, casehardened.

Shaft *D* carries two cones of four gears each, running loose on the shaft and driven independently by the gears on shaft *C*, the larger gear on *C* engaging the smallest gear on one cone, and the small gear on *C* engaging the largest gear on the other cone, thus imparting widely different speeds to the two cones.

The intermediate gear *E*, which slides on shaft *F*, can be brought into mesh with any one of the eight cone gears on shaft *D*, and from it motion is carried to the various feed screws. Gear *E* is brought into mesh with any one of the cone gears by shifting the two levers shown in Fig. 2. The lower lever slides the gear along the shaft *F* to the desired position by means of the toothed sector *a* and the rack *b*, while it is brought into mesh with the corresponding gear by shifting the upper lever, which moves the entire lower portion of the mechanism. This is accomplished by means of a helical groove *c* on the hub of the lever, which engages the pin on the slide *R*, carrying the gear *E* and shaft *F*, as shown.

By means of this mechanism sixteen different speeds are imparted to the feed shaft *F*, advancing by even gradations from 0.004 inch to 0.250 inch for each turn of the spindle. The rate at which the machine is feeding is indicated by the position of the lower lever by means of raised figures on the lever quadrant. This enables anyone to tell at a glance just how fast the machine is working.

From the foregoing it is plain that by simply shifting the levers on the feed mechanism, any one of the sixteen different rates of feed may be obtained, and a change from any one rate of feed to any other may be made without stopping the machine, since there are no change gears to interpose nor belts to shift. Any one of these rates of feed may be used in combination with any of the sixteen different spindle speeds, providing, in all, 256 different combinations.

The spindle speeds vary from 9 to 350 turns per minute and have been chosen with a view to secure the proper cutting speed for cutters of standard diameters. The table shows how well this has been accomplished and also shows how these speeds are obtained for the No. 3 Universal machine.

Table of Cutter Diameters adapted to the Spindle Speeds furnished on the No. 3 Universal Cincinnati Miller.

Spindle Speeds, Revolution per Minute.	Steel. Surface Speed, 20 feet per Minute.	Cast Iron. Surface Speed, 40 feet per Minute.	Brass. Surface Speed, 60 feet per Minute.	Cone Step for Belt.	Counter-shaft, Fast or Slow.	Back Gear, In or Out.
	Inches.	Inches.	Inches.			
9	8½	....	....	First	Slow	In
13	6	12	....	Second	Slow	In
15	5	10	....	First	Fast	In
19	4	8	12	Third	Slow	In
22	3½	7	10	Second	Fast	In
30	2½	5	7½	Fourth	Slow	In
34	2¼	4½	6¾	Third	Fast	In
51	1½	3	4½	Fourth	Fast	In
60	1¼	2½	4	First	Slow	Out
88	⅞	1¾	2⅝	Second	Slow	Out
103	¾	1½	2¼	First	Fast	Out
133	⅝	1⅛	1¾	Third	Slow	Out
150	½	1	1½	Second	Fast	Out
203	⅜	¾	1⅛	Fourth	Slow	Out
230	⅜	⅝	1	Third	Fast	Out
350	¼	½	¾	Fourth	Fast	Out

This feed mechanism is one of several new features adopted for the back-geared machines made by this company. The machines have been increased in weight, and provision is made for clamping the knee to the column and the saddle to the knee, insuring rigidity when the longitudinal feed is used.

* * *

The new battleship "Maine" has been successfully launched from the yards of the William Cramp Ship and Engine Building Co., at Philadelphia. The "Maine" is 56 per cent finished. Her keel was laid in April, 1899, and she is to be ready for transfer to the government in eighteen months' or two years' time, depending upon the delivery of her armor plates. The "Maine" is a sister ship of the "Ohio," recently launched at the Union Iron Works, San Francisco, and of the "Missouri," building at Newport News. She is 388 feet long on the water line, 72 feet 2½ inches extreme beam, 23 feet deep, and will have a displacement of 12,230 tons. She is to have a speed of 18 knots an hour. The main battery of the ship will consist of four 12-inch and sixteen 6-inch guns. Besides this, she will carry eight 14-pounders, eight 3-pounders and eight 1-pounders, and machine guns.

* * *

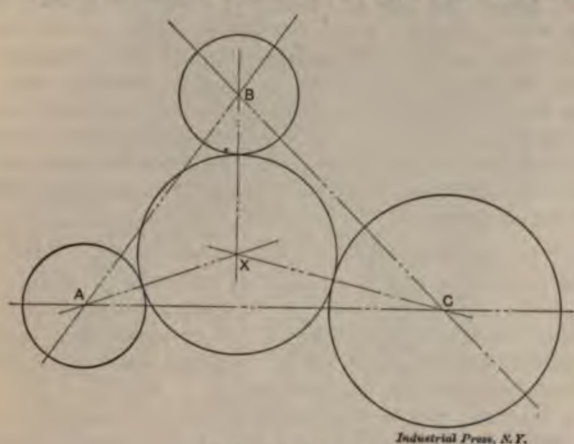
J. M. Westmacott, of Providence, R. I., a well-known manufacturer of gas furnaces, died suddenly on August 20th. It is probable that the business will be continued by the estate.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

"E. Lind" sends a sketch illustrating a problem in gearing which he would like to have submitted to our readers for a mathematical solution. Given the two gears of same diameter with centers at *A* and *B*, and third gear with center at *C*,



Geometrical Problem.

also given the distance from center to center of each of these three. Deduce the formula for obtaining the diameter of the gear which will mesh into all three given gears. Suppose, also, we have three gears of different diameters, so as to make a general case of it.

BABBITTING BOXES.

Chas. M. Spencer, Philadelphia, Pa., writes:

In the June number of your paper, Questions and Answers, page 56, I note that C. E. B. asks for information that will assist him in babbitting boxes. Heating is a very good thing; and also I think he will find it well to vent the box at each end. Most men, when they babbitt a box will stop every crack as tightly as they can, which makes the box air-tight, while the air must, on the contrary, be allowed to escape to make room for the metal. I always take the end of my scratch-awl and put it at the end of the box. Then I putty around it and draw out the scratch-awl carefully, so as not to break away the putty from the rest. Like C. E. B., I used to have some trouble with babbitting boxes, but after venting all trouble ceased.

1. S. M. D. M.: When using punches for punching cold steel and iron we find it difficult to punch pieces that are thicker than the diameter of the punch. Can you explain the difficulty and give a remedy? 2. What is the best method of holding feathers in shafting where the sudden strain is great? Should the feathers fit tight on the end? 3. Which is best, to straighten a shaft by pening or by bending it under a press? Also is it best to heat the shaft when bending it?

A.—Assuming that the material used for the punch is suitable to operate on the work that is to be punched, the main thing is to have the punch guided firmly and accurately in a straight line to prevent side strain. 2. It is best always, with either a feather or a key, to depend entirely on the side fit to sustain the strain. When a feather or a key is proportioned properly for its work and fits snugly on its sides, it will cause very little trouble unless the hub in which the shaft fits is too loose on the shaft. In the case of a hub being keyed to the shaft the latter should be forced into the hub or else the hub should be clamped to the shaft. A setscrew should never be put through the hub to bear on the key, nor should it be placed diametrically opposite the key. If setscrews must be used there should be two of them, and so spaced that the key and each setscrew will be 120 degrees apart. In case of a feather where the hub must slide on the shaft it is not possible to secure so great a degree of rigidity and there is always the possibility of trouble. 3. It is better to bend the shaft under a press. Pening affects the surface of the shaft only, and when this surface is turned off the shaft will spring again to a greater or less extent. Cold bending answers every purpose.

2. H. Y.: Kindly published rules for finding the weight of castings by measuring the patterns and also the weights of forgings by measurement.

A.—The finding of the weight of castings from patterns is a matter of difficulty since the weight of the patterns varies so widely. To find the weight of a casting made from white pine, multiply the weight of the pattern by 16; if yellow pine, by 12. This, of course, applies only when the pattern has no core prints—the casting being a duplicate of the pattern as regards weight. A better method, where the pattern is small enough to be conveniently handled, is to place it in a box of convenient size and fill in around the pattern with sand, shaking it down well and filling the box completely to the top. Then remove the pattern and level the sand so that the cubic contents may be readily calculated. Thus, if the box is 20 x 30 inches and the sand levels to 5 inches from the top after the pattern is removed, the cubic contents represented by the pattern would be $20 \times 30 \times 5 = 3{,}000$ cubic inches. Multiplying this amount by the weight of one cubic inch of cast iron—which is 0.26 pound—gives 780 pounds as the weight of the casting made from the pattern. In this case also the casting must be a duplicate of the pattern. If there are core prints they must be allowed for. To find the weight of a forging by measurement, multiply the number of cubic inches by 0.28, which will give the result in pounds, since the weight of a cubic inch of wrought iron is 0.28 pound.

3. H. B.: Please give me the receipt for making yellow pattern varnish in small quantities. 2. What is the principle of the Wellsbach gas mantle?

A.—Patternmakers' yellow shellac varnish is made by dissolving stick shellac in either wood alcohol or grain alcohol. The latter is the better and the more expensive. The common orange shellac is used, which gives the yellow color. Bleached or white shellac is not as good for the purpose. 2. In the Wellsbach lamp a Bunsen gas burner is used in which air is combined with the gas before burning. This makes a blue flame, which is very hot, but which gives very little light. Above the flame is hung the mantle consisting of a fabric that has been steeped in salts of some refractory earth. When the mantle first ignites the fabric burns out and leaves the refractory material, which then becomes incandescent through the intense heat of the blue gas flame. It is this incandescence which gives the light. Several compounds of refractory material may be used for the mantle, and for a list of these and the proportions in which the various elements are used we refer you to "Practical Gas Fitting," by Hasluck, a book which sells for a dollar.

4. J. W. D.: 1. When patterns have to be made for a new machine is it good practice to make one drawing for both the patternmaker and the machinist to work from? That is, should all dimensions be put on one drawing, or should a separate one be made for the patternmaker? Which is the most common practice? 2. When a draftsman makes a drawing which has to be machined to size should he put the finished sizes on the drawings without allowing for the amount of stock to be removed in finishing, or should this allowance be made by the patternmaker?

A.—It is very convenient for the patternmaker to have full-size pencil drawings furnished him of the details of machines, from which to work. This practice, however, is not generally followed, and when the drawings are carefully made there is really no need of it. The patternmaker has in any case to lay out the dimensions to full scale on the wood from which the pattern is made. It is very nearly as easy to do this by taking the dimensions from the drawings as by measuring directly from the full-size drawing. The method to be followed depends somewhat upon what the class of work is. Where a machine is to be designed and only one or a very few of the machines are to be built, it is best to put all the dimensions on the drawing, including both the dimensions of finished surfaces and of surfaces that are left rough, the radii of the curves of the castings for the benefit of the patternmaker, etc. Where a machine is to be built in quantities, however, it is best to put only the finished dimensions on the drawing, as a drawing made in this way is less confusing for the machinist, who will have to use it over and over. A blueprint can then be prepared especially for the patternmaker by adding to it the dimensions that he will need. 2.

It is customary for the patternmaker, and not the draftsman, to make the allowance for the metal to be removed in finishing. The amount to be allowed will depend first upon the capacity of the machines in the shop to remove metal, and secondly upon whether the castings themselves are strong enough to withstand a heavy cut. The custom is growing more and more to allow for the removal of considerable stock and to have machines heavy enough to take off this stock with one or two cuts. The practice of allowing a very small amount for finishing means that more time must be taken for setting up the work and for laying out, preparatory to machining; and that, even then, it may be difficult to get under the scale with the cutter or tool and that the total loss of time will more than offset any loss coming from removing a larger amount of metal.

Answered by Wm. Baxter, Jr.

5. X. Y. Z.: What is the cause of the zincs in a Leclanche cell becoming coated with a white slimy substance which causes the battery to cease working? I have four cells used for lighting the gas. The batteries do not last more than about three months after being charged. On examination I find that the zincs are coated with a white substance, and if this is removed they will work well for a short time and will then become coated again, and finally the carbons will become coated.

A.—The substance that deposits upon the surface of the zinc is a chloride of zinc. The cause of its depositing is that the solution becomes so diluted that it is not capable of dissolving the salts. The cure is to make the solution stronger and use more cells in parallel so as to reduce the strength of current through each one. The trouble may also be caused by not having the connections between the plates and the terminal pieces clean and as perfect as possible. Care should be taken to have the contacts at these points very clean, and the upper end of the carbon and zinc and also the top of the jar should be covered with melted wax or paraffine to prevent the salts from creeping and thus short-circuiting the cell. If short circuits develop the cells will soon run down even if the normal work required of them is light. We would advise you to try "dry cells." They can be obtained from any dealer in electrical supplies and are very cheap, perfectly clean, and give no trouble.

* * *

MINIATURE MICROMETER.

A miniature micrometer caliper, designed for a watch charm, is illustrated herewith. It is only 1 inch in length, is 14 carat gold filled, and the manufacturers, the Sterling Watch Tool Co., Rochester, N. Y., guarantee that it will wear for twenty-five years. The anvil is adjustable for all

Fig. 1.

Fig. 2.

wear, and this small caliper is in every respect a good measuring instrument. The anvil and point of the spindle are of 10-carat solid gold, and take the place of the hardened steel tips on the regular micrometer. The 10-carat gold is much harder than the 14-carat; and the wear therefore is reduced to a minimum, as the points are of solid gold and show no perceptible wear. It will measure accurately in thousandths of an inch, all sizes less than three-sixteenths. The metric measure is also applied to this diminutive caliper, although the manufacturers state that English measure will always be sent unless otherwise ordered. It is sent in a velvet-lined leatherette case, and the price of caliper and case is $2.50.

* * *

This number of MACHINERY is the first issue of Volume VIII. The index for Volume VII. is now ready for distribution and will be sent free of charge to any subscriber applying for it. Address the INDUSTRIAL PRESS, 9-15 Murray Street, New York City.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

A neat tool has been brought out by the L. S. Starrett Co., Athol, Mass., for use on electrical instruments and other small work. The tool is a screw driver which is also a screw placer. The point of the screw driver is split, making two spring blades similar to the nibs of a drawing pen. In using, the blades are compressed and introduced into the slot of a screw, when the latter will be held by the outward spring of the blades. The screw can then be placed in position and given two or three turns and finally driven home with a solid screw driver.

AUTOMATIC CHUCKING MACHINE.

The automatic chucking machine illustrated in Fig. 1 is one of the new tools exhibited at Buffalo by the Cleveland Machine Screw Co., Cleveland, O. It operates upon castings or forgings held in the chuck of the lathe and has a capacity for work up to 18 by 18 inches.

The machine has four changes of spindle speed, two with open belts and two through the use of back gears. Changes in feeds range from zero to the highest required. It is full automatic in all its movements, including changes of feed

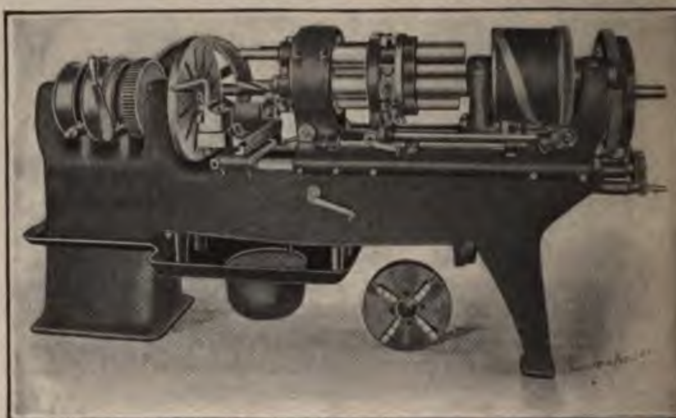


Fig. 1. Automatic Chucking Machine.

and spindle speed, and it is designed so that each tool can have the maximum feed and periphery speed of work that it can stand. There are five tool spindles carried by a disc which is capable of rotating in the frame or head that supports it, as clearly shown in the illustration. Each spindle is advanced in turn at the required speed and is then withdrawn and the disc rotated until the next spindle comes in line with the lathe center. The movements are obtained through the two cylindrical cams at the rear end of the machine. The cross slide, with tool posts front and back, operates automatically through a cylindrical cam at the rear of the head stock. The frame is rigid and is supplied with an oil drip pan and oil well, allowing a bountiful supply of oil to be used when the work requires it. The idea of applying the automatic principle of the screw machine to a chucking machine for operating upon work held in the chuck is an important step in the direction of cost reduction in machine work, and machines that have been designed for this purpose are a noteworthy advance in the development of machine construction.

CRANK SHAPER.

The Prentiss Tool and Supply Co., New York City, have brought out a new crank shaper, which, although embodying the essential features of their older shaper, has several points of distinct advantage over it. The engraving, Fig 2, is a view of the 26-inch stroke size of the new shaper, which machine is on exhibition at the Pan-American Exposition. A changing plate, shown conveniently located at the side of the machine, was mounted on it by two studs carrying com-

ound gearing by which it is possible, by simply throwing in iesh one or the other of them, to obtain eight changes of peed from a four-step cone, thus allowing quick motions or brass and other soft metals, or the regular speed. A

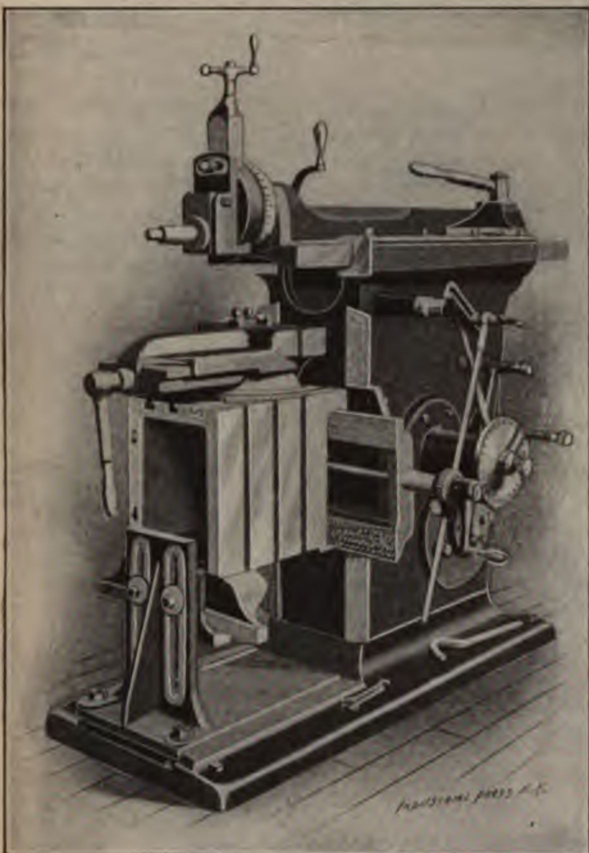


Fig. 2. New Prentiss Shaper.

ovel steadying device for the table is furnished in the way f a knee, shown at the lower front part of the machine, hich may be clamped to the table in any position in which is set. This offers the advantage of great rigidity for king heavy cuts. The change f stroke in this machine is ac- mplished while it is in motion, y the small crank shown at the de, the quick return being ob- ined by a link motion placed the column of the base. The aring in all sizes of the shaper made very strong, and the iving cones are arranged for undantly large belts. The hol- w construction of the base un- er the ram permits of cutting eyways in bars or shafts by assing same through the hollow nder the ram.

MPROVEMENT IN GISHOLT LATHE.

In Fig. 3 is an illustration of a 4-inch Gisholt turret lathe, such s is exhibited at Buffalo by the isholt Machine Co., Madison, Vis. It is direct-connected to a Northern" motor.

A new feature of the lathe is a simple device for moving e turret back and forwards by power, through the action a hand lever. The lathe is equipped with both a carriage d turret and in case the turret has been used and the xt operation is to be done with the carriage, the operator ed simply to throw in the lever and the turret will move ck to the proper place and the driving mechanism will be rown out automatically. The operator, therefore, can con- nue working with the carriage without having to pay any ttention to the turret. As the tools on the turret are ranged so that the turret is well balanced it is an easy matter, after starting the turret to move backward, to revolve the turret while the slide is in motion. In this way no time is lost in performing this operation, and as the turret can be moved back and forth at a high rate of speed, considerable time can be saved as compared with the hand traverse.

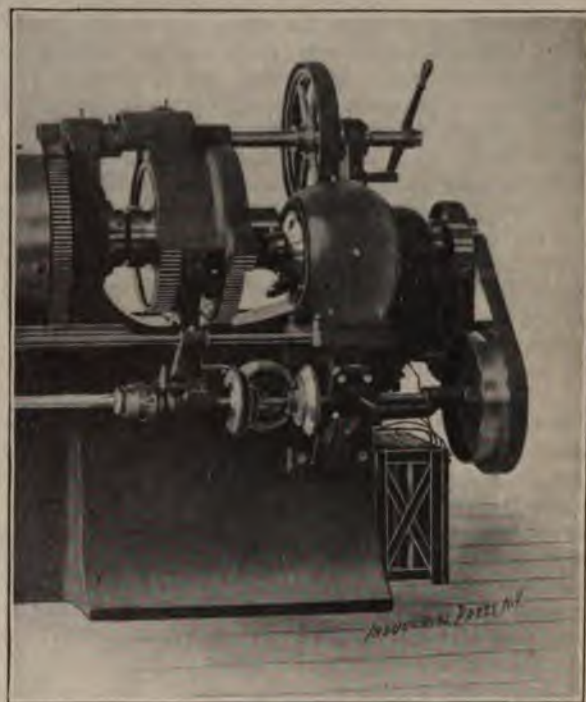


Fig. 4. Motor Arrangement of Lathe.

The machine at Buffalo is equipped with the tools for finishing a commutator, and which show the advantage of being able to operate the carriage and turret simultaneously. A Gisholt tool grinder is also on exhibition in which the wheel is driven by a motor placed on the wheel shaft. The motor is dust proof and the arrangement is found very satisfactory.

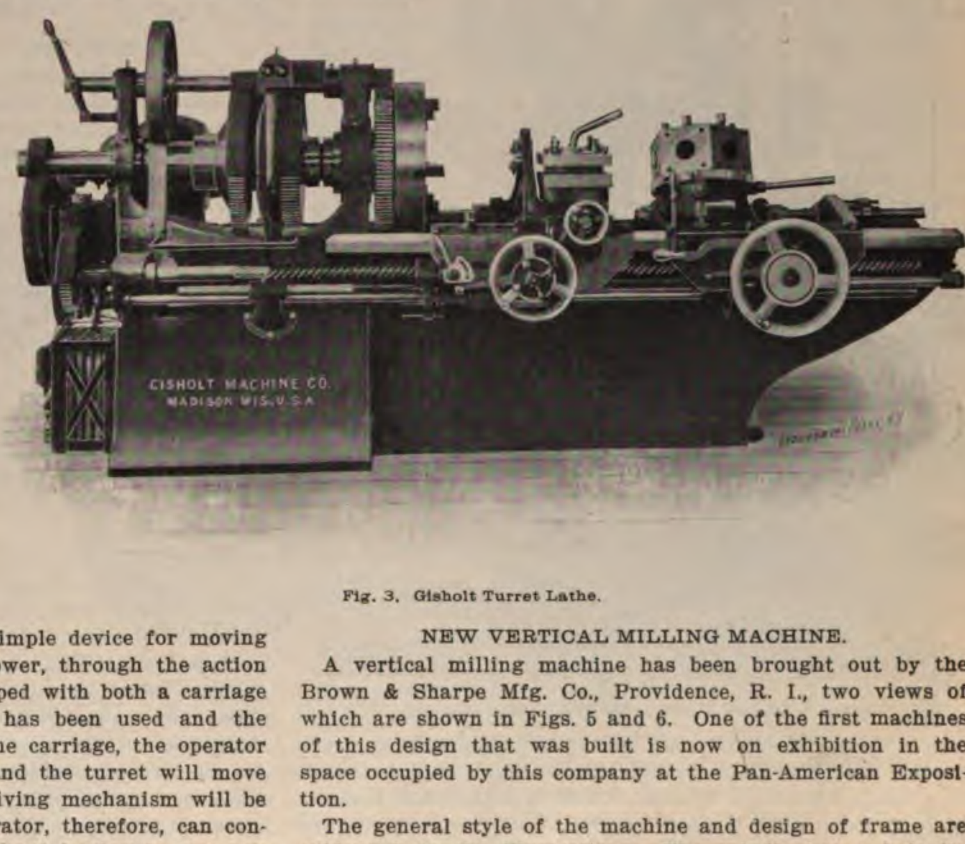


Fig. 3. Gisholt Turret Lathe.

NEW VERTICAL MILLING MACHINE.

A vertical milling machine has been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I., two views of which are shown in Figs. 5 and 6. One of the first machines of this design that was built is now on exhibition in the space occupied by this company at the Pan-American Exposition.

The general style of the machine and design of frame are evident from the illustrations. The spindle has a hole its entire length and runs in bronze boxes. The lower box is provided with means of compensation for wear, and the

driving pulleys run on phosphor bronze sleeves instead of directly upon the spindle, thus relieving the latter of belt pull. Twelve spindle speeds are obtained, varying from 85 to 1,260 revolutions. These changes are obtained by two countershaft speeds in conjunction with three steps on the cone at the back of the machine, and two other speed changes through a special arrangement of belts for driving the spindle. The main belt passes from the cone shaft at the rear of the machine and drives the large pulley on the spindle, which gives one of the speeds. The other one is obtained through two auxiliary belts, one of which runs from the large spindle pulley to the double pulley on the vertical shaft at the rear of the column. This belt passes underneath the main belt, the latter riding upon it as it passes over the large spindle pulley. The other auxiliary belt runs from the upper pulley on the vertical shaft to the small pulley on the spindle. By an arrangement enabling the large spindle pulley to be disconnected so that it will run freely, and the small one made fast to the spindle, the latter can be driven at a high rate of speed through the two additional belts.

The vertical shaft at the rear of the machine also serves to drive the feeding mechanism for the table. This mechanism, shown at *A*, Fig. 6, is new in design. The various changes can be easily obtained by the movement of the hand lever *B*. The lower cone of gears in this mechanism is driven from the vertical shaft through bevel and spur gears and an upper cone of six gears behind the index plate is driven through an intermediate gear held by a yoke at the lower end of the controlling lever, *B*. To change the feed it is only necessary to unlatch the lever and slide it along to the desired feed plainly indicated on the index plate, and latch it into position under the feed indicated. The feed is carried from this mechanism to the table through spur gears and a universal joint.

The small lever *C* at the top of the index plate is for quickly changing the feed from fast to slow, or *vice versa*. This lever controls a clutch that engages gears on the shaft

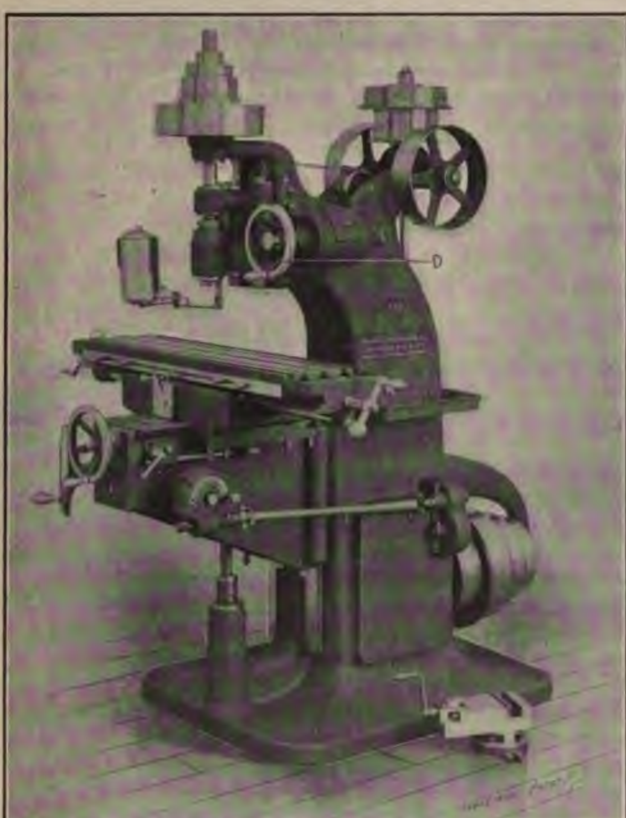


Fig. 5. Brown & Sharpe Vertical Milling Machine.

which drives the universal joint. It is possible to obtain twelve feed changes ranging from 0.005 to 0.125 inches to one revolution of the spindle. There is a fine hand feed and a quick return for the spindle head, both of which are operated by one handwheel shown at *D*, through a differential mechanism that will give either the slow or the rapid motion. This is a simple and novel feature, enabling the machine to be used as a drill press for work already in position for milling. A micrometer stop, shown at *E*, is graduated to thousandths of an inch, and controls the depth of the cut.

The lower end of the spindle has a No. 10 B. & S. taper hole and cutters and arbors are held by a bolt passing through

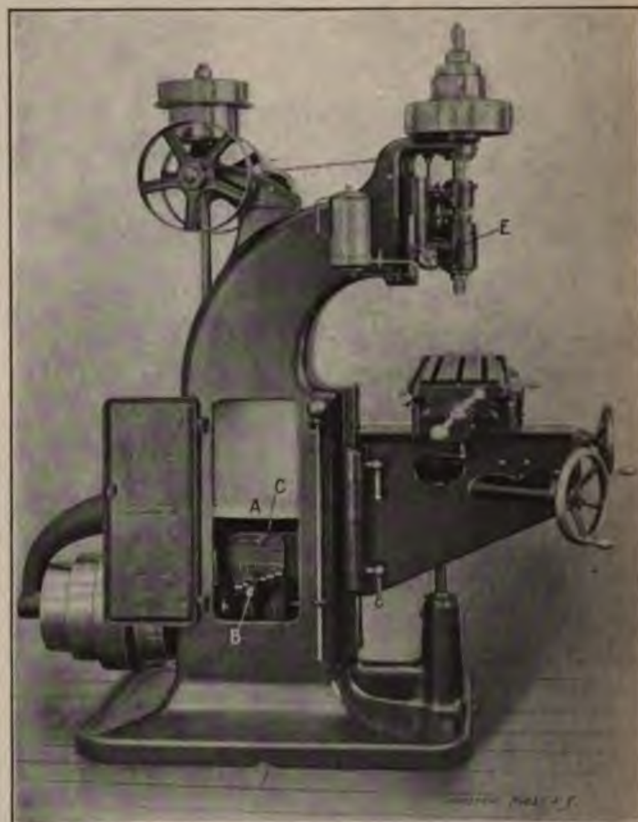


Fig. 6. View showing Feed Gears.

the spindle. The distance from the center of spindle to column is 16 inches, vertical movement of head, 4 inches. The table is 45 inches long, 10¼ inches wide, has a transverse feed of 12 inches, and can be lowered 16 inches from the end of the spindle. The longitudinal feed is 26 inches.

MOTOR-DRIVEN VERTICAL DRILL PRESS.

The accompanying cut, Fig. 7, on the next page, illustrates a 48-inch vertical power-feed drill press, with direct-connected electric motor, which Gould & Eberhardt, Newark, N. J., have just furnished to the United States Navy Yard at Norfolk, Va. This machine, which is the fifth drill press they have furnished to this yard, is fitted with the Eberhardt automatic tapping attachment, shown at the left of the drill spindle. This attachment is used for tapping up to 1½ inch, and work after being drilled may be rapidly moved across and centered under the tap by means of the compound traverse table. The drive is fitted with friction clutches, shown at the rear of the machine, to obtain right or left motion for the drill spindle, for large tapping. Straight belts are used for this, instead of the usual crossed belts, the necessity for a crossed belt being overcome by a reverse pulley shaft, in addition to the driving pulley mounted on the armature shaft of the motor, which is coupled to the armature shaft by a pinion at its end.

The portable compound chuck shown at the top of the drill table is used in connection with the drill press for vertical profiling or milling dies, punches, cams and other irregular shapes, and reduces the necessity of a special machine for that purpose. The table and base plate are large and sufficiently braced to maintain perfect rigidity for the machine. The column is practically one casting, and together with back brace forms a very strong construction, the back brace to the column counteracting the pull of the cone belt and thus preventing any possible springing or deflection. An index is placed on the feed rod, which tells at a glance the proper feed for any size drill within the range of the machine. This feed is entirely independent of the drill spindle, and changing the speed of the drill does not affect the feed

arrangement. Also an automatic stop and depth gage throws out the feed after drill has reached the required depth. The back gears are arranged so that one movement of a lever releases the cone from the shaft and engages the gearing, and changes the feed ten times coarser, while one movement in the opposite direction disengages the gearing. The spindle head is vertically adjustable, and can be raised or lowered and clamped in position. A square quill is used in place of the usual round sliding barrel, which adds to the rigidity of the spindle in boring deep and rough holes. Feeding can be done automatically, or by hand, up or down, separately through the head the entire length of planed surface on the column, or independently through the rack on the quill. All changes are made from the front of machine, thus allowing the operator to remain in the one position, directly before his work.

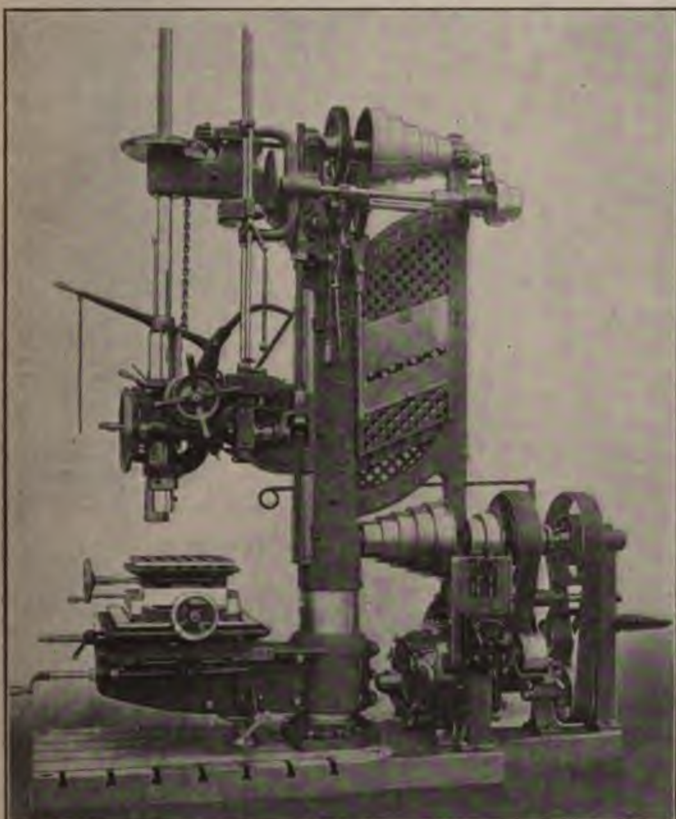


Fig. 7. Eberhardt Drill Press.

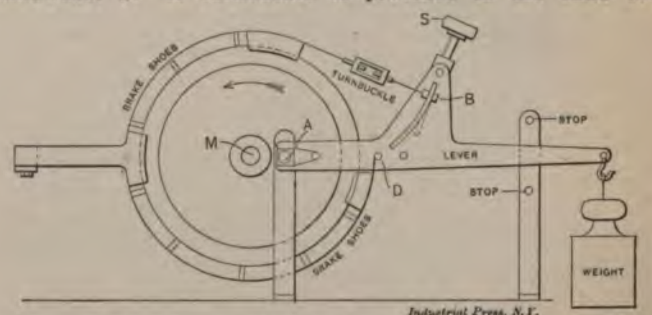
COMPRESSION SHAFT COUPLING.

A novelty in the way of a compression shaft-coupling is shown in the accompanying illustrations, Figs. 8 and 9. Fig. 9 shows the parts of the coupling separated and Fig. 8 shows them assembled as they appear when in use. The coupling consists of a coupling proper, which resembles a pulley with its hub split into three parts, to allow each being forced inward against the shafting. A small amount of radial motion is permitted in these parts of the hub by the peculiar arrangement of the spokes shown in Fig. 9, the spokes being set tangentially to the hub instead of radially. The outside of the hub is turned off tapering on each end and compression collars, or flanges, shown also in Fig. 9, are turned to fit snugly on their tapering ends. Then, when it is desired to use the coupling, the coupling hub is brought over the joint in the shafting and the compression flanges drawn together up over the hub ends, by the bolts shown, which wedges the hub sections firmly upon the shaft. Thus the coupling is effected by the friction due to the intense pressure upon the shaft, and no keys are required, which is a great convenience, as it can be ordered and put up without any extra fitting. The coupling is manufactured by the W. P. Davis Machine Co., Rochester, N. Y.

Fig. 8.

NEW PRONY BRAKE.

The *Mechanical World* describes a new Prony brake which is in use in the works of Siemens & Halske, Charlottenburg, Germany. The lever arm is pivoted at *A*. The band carrying the brake blocks is connected to the lever at *D* and *B*. The brake blocks are hollow and provided with internal water circulation for cooling. The faces of the brake shoes are smeared with tallow, and no water is allowed on the friction surfaces. The block *B*, to which the band is attached, moves in a curved slot, being controlled by the screw and handwheel *S*. A turnbuckle is provided in the band for



tightening the grip of the blocks. A very close regulation may be obtained by means of the various adjustments, since the coefficient of friction fluctuates very slightly owing to excellent lubrication and absence of water from the friction surfaces. It is necessary that the center *M* of the shaft, the pivot at *A* and the point of attachment of the weight to the lever all be in the same straight line parallel to the ground line.

* * *

The Hamburg-American steamer *Deutschland* sailed from New York July 11 and arrived at Plymouth July 17, making the trip in 5 days, 11 hours and 5 minutes. While this is not the quickest trip made by the *Deutschland* between Sandy Hook and Plymouth, it is the best record for the long course. On this trip she made an average run of 23.51 knots an hour.

* * *

PAN-AMERICAN SEARCH LIGHT SIGNALS.

Signals from the 30-inch search light, on the Electrical Tower of the Pan-American Exposition, were sent to Niagara Falls, July 25th, by Prof. Geo. F. Sever, Superintendent of Electrical Exhibits, in the presence of the electrical jury, thus demonstrating the feasibility of this method of signalling at night.

Since that time search light signals have been sent from Buffalo to Toronto, a distance of 58 miles, through arrangements completed by Prof. Sever in co-operation with Mr. Wm. S. Aldrich, consulting electrical engineer, of Toronto. The first trial was made on the evening of August 9, with clouds over Toronto. The local illumination of the overhead sky by the electric arc light in the streets of Toronto effectually prevented any discrimination being made between the local and the Buffalo illumination of the clouds. The second trial was made on the evening of August 13, with a

Fig. 9.

perfectly clear atmosphere. Owing to the smoke settling down over the city, no signals could be discerned from the top of the Municipal Hall Tower, Toronto. This was the prearranged objective point for both experiments.

Special long-distance communication was arranged between the top of this tower and the Electric Tower, at the Pan-American, through the courtesy of the Bell Telephone Co., of Ontario, represented by Mr. K. J. Dunstan, of Toronto, so that every detail of the experiment could be followed. The

special instructions were to depress the search light to the lake horizon, bearing on the Municipal Hall Tower, Toronto, then to sweep the horizon a definite angle, to the right and left of this bearing, and later to elevate and depress the light at the original bearing. All of these signals were very clearly discerned during the second trial two miles off shore from the city.

* * *

FRESH FROM THE PRESS.

THE TEXTILE WORLD'S OFFICIAL DIRECTORY FOR 1901. Published by Guild & Lord, 620 Atlantic Avenue, Boston, Mass. Price, linen-covered edition, $2; bound in cloth, $2.50.

This is a most valuable work of reference to everyone interested in the textile industries, and is divided into five parts, as follows: Part I.—Textile Manufacturers. Part II.—Agents and Buyers of Textile Fabrics. Part III.—Dealers in Raw Materials. Part IV.—The Yarn Trade Index. Part V.—Classified Lists of Commission and Order Mills, Dyeing and Finishing Establishments, etc.

All the textile establishments in the United States are arranged by location alphabetically under States, Cities and Towns, with maps showing the location of the textile mill cities and towns in the principal manufacturing states. The 1901 edition contains a yarn index, commission mill list, shoddy mills, and many pictures of mills—all features of value and interest to those in the textile trades.

The directory is in every sense an original work, all the firms represented being verified by actual personal and mail canvas, so that no "dead timber" is represented. Every effort has been made to have it correct in all details and to insure its accuracy a reward is offered for the first discovery of all omitted firms.

A HAND BOOK FOR APPRENTICED MACHINISTS. Edited by Oscar J. Beale. 141 16mo pages, bound in cloth, fully illustrated. Published by Brown & Sharpe Manufacturing Co., Providence, R. I. Price 50 cents.

This book was primarily issued for the instruction of the apprentices in the shops of the Brown & Sharpe Manufacturing Co., but until the appearance of this edition had never been published. It has been issued to the public in response to the general call for a work of this character from the apprentices and others in the machine shops of the country. It may also be read with profit and interest by almost any experienced machinist.

The various subjects are: Care of Machines, Tools and Work; Centering and Care of Centers; Turning, Reading Drawings, Measuring, Lacing Belts; Signs and Formulas; Drilling, Counterboring, Tapping, Cutting Speed; The Screw and its Parts; Figuring Gear Speeds; Figuring Pulley Speeds; Change Gears for Screw Cutting; Angles, Setting a Protractor, Working to an Angle; Circular Indexing; Straight Line Indexing; Subdividing a Thread, etc.

The subject matter is treated in a plain and simple manner, which makes it easily comprehended by anyone of ordinary education. It is a book that should be popular with young machinists, as we know of no reliable work of a similar character which contains so much mechanical information gotten up in convenient form to sell at so low a price. It would undoubtedly be a profitable investment for many of the large machine building firms throughout the country to place this book in the hands of their apprentices, as in no other way could they impart to such employees so much reliable information at so little expense.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

WALWORTH MFG. CO., Boston, Mass. Pamphlet of the Van Stone pipe joint. This is a pipe joint without threads or rivets, and is adapted to extremely high pressures.

STOW MFG. CO., Binghamton, N. Y. Catalogue No. 9, descriptive of the Stow flexible shaft, and the Stow multi-speed electric motor. Illustrations are shown of many applications of both.

ROCKWELL ENGINEERING CO., New York City. Catalogue of furnaces for the heating of metals or any other materials by use of any desired kind of fuel. A specialty is made of oil or gas annealing and hardening furnaces.

BUFFALO FORGE CO., Buffalo, N. Y. Pamphlets of the Buffalo disk wheels for ventilating, cooling and drying, and steel pressure blowers for all service requiring high pressure air blast.

NORTHERN ENGINEERING WORKS, Detroit, Mich. Catalogue No. 50, descriptive of the Newten cupola. The features of the new design and their patented tuyere system are described.

FRANKLIN MACHINE WORKS, Philadelphia, Pa. Catalogue of plain milling machines, cold saw cutting-off machines, automatic saw sharpening machines and horizontal boring machines.

EMPIRE ENGINE AND MOTOR CO., Orangeburg, N. Y. Catalogue No. 2, descriptive of their Empire air tools, including pneumatic chain hoists, drills, reamers, center grinders, crane motors, winches, etc.

NEW HAVEN MFG. CO., New Haven, Conn. Catalogue illustrating their iron planers, engine lathes, drilling machines, slotting machines, boring mills, and automatic turrets.

LEWIS TOOL CO., New York City. Catalogue No. 6, descriptive of the Lewis double steel sliding bar vises. These vises are made in all styles of adjustable back jaw, swivel base, self-adjusting, quick-acting, etc.

AJAX MFG. CO., Cleveland, O. Ajax red book, descriptive of Ajax upsetting and forging machines, bolt heading and rivet making machines, bulldozing and bending machines, nut machines, and nut-tapping and bolt-threading machines.

WILMARTH & MORMAN CO., Grand Rapids, Mich. Catalogue descriptive of the New Yankee drill grinder, and a folder descriptive of the Wilmarth friction countershaft, which was recently described in these columns.

BECKER-BRAINARD MILLING MACHINE CO., Hyde Park, Mass. Catalogue No. 53 of vertical milling machines. The advantages of vertical spindle milling machines are outlined and numerous views of its work are shown by photographs.

THE ANDERSON TOOL CO., Anderson, Ind. Catalogue of the Lea electrically-driven universal grinders. The headstock spindle and the grinding heads are each direct driven by separate motors, which allows the greatest flexibility.

J. T. SLOCOMB & CO., Providence, R. I. Catalogue of machinists' tools, comprising micrometer calipers of all sizes, tube and screw thread micrometers, special micrometers, depth gages, standard end measures, etc.

THE CHICAGO FLEXIBLE SHAFT CO., Chicago, Ill. Illustrated catalogue of the Stewart gas blast furnaces and rotary pressure blowers. A very complete line of gas furnaces is presented, including muffle furnaces, crucible and forge furnaces, case-hardening and annealing furnaces, and automatic furnaces for a great variety of work. A novel tempering furnace is described, in which a crucible of melted beef-tallow is used for drawing tempers. The melted tallow may be maintained at any desired temperature by keeping a pyrometer suspended in it, and thus the temper to which a tool will be drawn is reduced to an absolute certainty.

MANUFACTURERS' NOTES.

THE NORWALK IRON WORKS CO., South Norwalk, Conn., are adding a large foundry to their establishment.

MR. FREDERICK BROTHERHOOD has been appointed manager of the foreign sales department of the Railroad Supply Co., with headquarters at their New York store, 106 Liberty St.

SAM LAGERLOF, importer and exporter of tools and machinery, Stockholm, Sweden, announces that he has started a machine bureau, and is open for all quotations for all kinds of machine tools, and wishes to receives catalogues relating to same.

THE PHILADELPHIA MACHINE TOOL CO., Philadelphia, Pa., inform us that Mr. Gus. C. Henning, the well-known engineer and specialist on testing of metals, has made them sole agents for his apparatus, which they will handle with their regular testing machine business.

THE STANDARD TOOL CO., Cleveland, O., have just issued their new Red Shield catalogue for 1901. This illustrates many entirely new tools, and contains some useful tables and general information and a very convenient telegraphic code. It also contains price lists covering all the regular sizes, with a complete index at the end.

THE KILBOURNE & JACOBS MFG. CO., Columbus, O., announce that they have recently issued several new catalogues, as follows: No. 7, No. 31, and No. 33, illustrating vehicles of all kinds for transporting baggage and freight. Among these are skids, mine, mill and industrial cars, dump cars, wheelbarrows of all kinds, etc.

THE SCRANTON CORUNDUM AND EMERY WHEEL CO., Scranton, Pa., are now occupying a new factory and office building which they have recently erected on Capouse Ave., Scranton. A feature of their abrasive wheels is that they are so designed that it is impossible for a wheel to burst in a way to result in injuries to the operator.

THE WILMARTH & MORMAN CO., Grand Rapids, Mich., state that late in July they received in one day orders for fourteen "New Yankee" drill grinders, several for export, and four machines for the U. S. government. They also state that Baker Bros., Toledo, O., have contracted with them to furnish the Wilmarth friction clutch on their line of keyseaters.

THE BINSSE MACHINE CO., Newark, N. J., successors to the Newark Machine Tool Works, have been awarded the contract for the entire horizontal boring machine equipment of the British Westinghouse Co., Manchester. The present order consists of three 6-foot table machines and three large double-head machines for boring the street car motor frames.

MR. JAMES C. HEMPHILL, formerly in the employ of C. B. Cottrell & Sons Co., Westerly, R. I., announces that he has started in business under the firm name of the Rogers & Hemphill Machine Co., Alfred, N. Y. This firm will be engaged in the manufacture of machine tools, and at present they are making a specialty of vertical boring and turning mills. The Prentiss Tool and Supply Co., New York, are their selling agents.

THE NEW PROCESS RAW HIDE CO., Syracuse, N. Y., have received a contract from the United States Mint, Philadelphia, for six New Process noiseless pinions 16 inches diameter, 6 inches face. These pinions are a part of the equipment of the new mint building, the machinery for which is just being installed. They are to be used for transmitting power from a 50 horse power motor to a 10-inch by 9-inch rolling mill, and will run 175 R. P. M., meshing into a 60-inch iron gear. Six armature pinions for the same motors were also shipped by the company recently. They are 12 2-3 inches diameter, 4 inches face, and will run at a speed of 525 R. P. M. The company has just made a shipment of 24 pinions to the Sao Paulo Light and Traction Co., Sao Paulo, Brazil.

MANNING, MAXWELL & MOORE, New York, inform us that Mr. Walter M. Wood, formerly associated with the Niles Tool Works, has now accepted a position with them and will represent Manning, Maxwell & Moore, operating from their new store, 128 Oliver St., Boston. Mr. G. E. Randles, formerly with the Pratt & Whitney Co., Hartford, is now representing Manning, Maxwell & Moore at their Philadelphia office; and Mr. David Hunt, Jr., formerly connected with their New York office, is now representing them at the Cleveland office, located in the Williamson Building.

THE BUFFALO FORGE CO., Buffalo, N. Y., have, in addition to their chief exhibit at Machinery Hall, several other installations on the Pan-American Exposition grounds. In the building designed for the Buffalo Historical Society they have installed a complete fan system apparatus for heating and ventilating, the fan being so made as to give a complete change of air every ten minutes. In the service power houses they have placed a 17 x 28 x 18 Buffalo horizontal tandem compound engine with automatic flywheel governors and self-oiling system. Also a Buffalo mechanical induced draft apparatus. In the Electricity Building they installed two 80-inch down-blast steel plate fans driven by induction motors.

CHARLES H. BESLY & CO., 10 and 12 N. Canal St., Chicago, Ill., report that they are receiving many orders for chucks, vises, power hack saws and general supplies. They state that they have never sold as many Gardner grinders and Besly band machines as at the present time, recent shipments having been made to New York, Pennsylvania, New Jersey, Massachusetts and Rhode Island. They call special attention to their new spiral paper circles to be used on Gardner grinders. They are now able to produce abrasive circles suitable for work on steel, cast iron, drop forgings, malleable iron, aluminum and the alloyed metals, gutta percha and wood. Samples of these new circles for trial will be sent to users of their machine without charge. When ordered, state metal to be ground.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., wish to call attention to the fact that they will withdraw their offer of a free scholarship on September 30 next. This free scholarship is an excellent opportunity for the ambitious mechanic to obtain a technical education. This school makes a specialty of steam, electrical and mechanical engineering, heating, ventilating and plumbing, and mechanical drawing. They state that the courses have been carefully laid out by prominent educators and engineering experts, and embrace every subject required by the up-to-date engineer and mechanic to master the theoretical details of his daily work. The tuition has been placed low so that no mechanic shall be debarred from receiving the benefit of the course. A handbook describing the School's methods and courses will be sent to any one on receipt of a postal card request.

THE NICHOLSON FILE CO., Providence, R. I., announce that they have purchased of the J. Barton Smith Co., Fourth and Somerset Sts., Philadelphia, Pa., the file and rasp manufacturing business heretofore carried on by them in that city, including all of the machinery, tools, stock of goods, patents and good-will of that company. Payment should be made to the J. Barton Smith Co., Philadelphia, Pa., for all charges by them prior to August 1, 1901. Remittances for all bills of files and rasps rendered on and after August 1, 1901, as well as all orders, should be sent direct to the Nicholson File Co., Providence, R. I. They solicit the continued patronage of all those who have handled the file and rasp products of the J. Barton Smith Co., assuring them that the quality of these goods will be maintained in every particular, and that their business shall receive their prompt, careful and courteous attention.

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MACHINERY

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A PRACTICAL JOURNAL FOR THE MACHINE SHOP

ONE DOLLAR A YEAR - TEN CENTS A COPY

MACHINERY.

Vol. 8. October, 1901. No. 2.

THE WESTINGHOUSE ELECTRIC & MFG. CO.'S WORKS.

SOME INTERESTING THINGS SEEN AT THE IMMENSE MACHINE SHOPS OF THIS COMPANY.

A few miles out from the smoky city of Pittsburg, on the line of the Pennsylvania Railroad, are three great manufacturing establishments bearing the name of Westinghouse, and noted the world over for their enterprise and progressiveness as well as their products—the Westinghouse Electric and Manufacturing Company, about twelve miles from Pittsburg, at East Pittsburg, Pa.; the Westinghouse Machine Company, of the same place, and the Westinghouse Air Brake Company, located about two miles further east, at Wilmerding. So well known are the products of these plants that it seems scarcely necessary to state that the first-named plant makes electrical machinery and apparatus; the second, steam and gas engines, and the third, railroad air brake apparatus.

The Westinghouse Electric and Manufacturing Company, the subject of the following notes, is one of the largest electrical manufacturing companies in the world, employing in the East Pittsburg establishment alone between 6,000 and 7,000 people, of whom about 1,200 are women, and having a shop floor space aggregating about 23 acres. The main works building is 1,200 feet long and 370 feet wide. It is more properly two distinct structures, having a common fireproof division wall which divides it longitudinally into two parts 295 feet wide and 76 feet wide, and each 1,200 feet long. The narrower section is the warehouse and power house. The shop proper is divided into four sections of approximately equal width and 1,200 feet long. The first floor sections are lettered A, B, C, D, and will be referred to hereafter under that designation. Two of the sections, B and D, have a clear open space from the floor to the roof, and are used for the erection of large electric generators, and also contain the heavy stationary and portable tools used in their construction. The sections A and C have two floors, the upper floors, sections E and F, being the same, of course, as galleries to the floors in sections B and D. Beyond the main building from the works' office are the new copper shop, a building 600 feet long; the blacksmith shop, brass foundry, the sheet iron punching and heavy copper bending departments, casting storage, carpenter shop, etc. All the shops are of modern construction, well lighted by many windows and skylights, and, of course, are electrically lighted at night. They are heated and ventilated in winter by the forced circulation of hot air.

Fig. 1. Interior View of One of the Main Sections of the Machine Shop, 1200 feet long.

All the machinery is driven from one central station, and, with the exception of the compressed air-driven tools, they are driven by electrical transmission, the polyphase system of generators and motors being used, with the exception of those necessary for the operation of the 31 traveling cranes

scattered throughout the works. The cranes are supplied with direct current at 550 volts. The power house is 75 feet wide by 255 long, the engine room being 125 feet long, and the boiler room 130 feet. The boiler equipment is entirely Babcock & Wilcox. In the engine room are five Westinghouse compound engines of 500 H. P. each, driving alternating-current generators supplying current at 220 volts and 3,000 alternations per minute. There are also two Westinghouse 500 H. P. compound engines driving two direct current generators supplying current at 550 volts to the traveling crane motors. The seven steam engines just mentioned are direct-connected to the electric generators. A 200 H. P. three-cylinder gas engine is direct-connected to a direct-current generator having a voltage of 500 volts which is used to help out the other two direct-current sets. There is also a 650 H. P. direct-connected three-cylinder gas engine direct-connected to a 400 K. W. rotary converter of 220 volts and 3,000 alternations. There is also a 300 K. W. rotary converter of 7,200 alternations for lighting the office buildings. The exciting current is furnished by a 75 H. P. Westinghouse compound steam engine direct-connected to a 220-volt multipolar generator. The two large air compressors for supplying the pneumatic tools are also included in the power house equipment.

The distribution of power is effected by both the group system and the unit system. In the group system the machines are operated from motor-driven lineshafts, a lineshaft throughout one section being generally in line the same as though driven as one unit, but divided into short sections which may or may not include all the machinery in one of the sub-departments. The motors driving these sections are usually mounted above the floor on a level with the lineshaft, and two are often placed close together, each driving adjacent lineshaft sections. The unit system of electric driving is quite generally used on the large floorplate. The motors used are of the constant-speed type, which makes some variable-speed device desirable for quickly obtaining the proper speeds. For this purpose the Reeves variable speed countershaft is extensively employed and is well liked. The method of application of the electric motor for individual machine driving varies, of course, with the type of machine and the conditions of its use. For the purpose of illustrating some of the features of unit driving the photographs Figs. 2 to 8, inclusive, are given.

Fig. 4 shows a Pratt & Whitney double-spindle tube-drilling machine operated by two Tesla polyphase induction motors. The motor at the headstock end drives the spindles through reduction gearing. The motor at the opposite end drives the oil pumps for forcing oil through the oil tube drills used in drilling the long holes through armature shafts, etc. As is generally known, this type of motor has no commutator or collector rings, the rotating part being entirely isolated from the primary circuit or stator which corresponds to the field magnets in the direct-current motor. This field acts on the secondary winding in the motor and induces current therein. The reaction between these induced currents and the rotating magnetic field in the primary produces rotation of constant torque and speed. If overloaded the motor stops without damage to itself or connections. It will be observed that the wiring to the motors is inclosed in gas pipe and secured to the base of the machine in a permanent and safe manner.

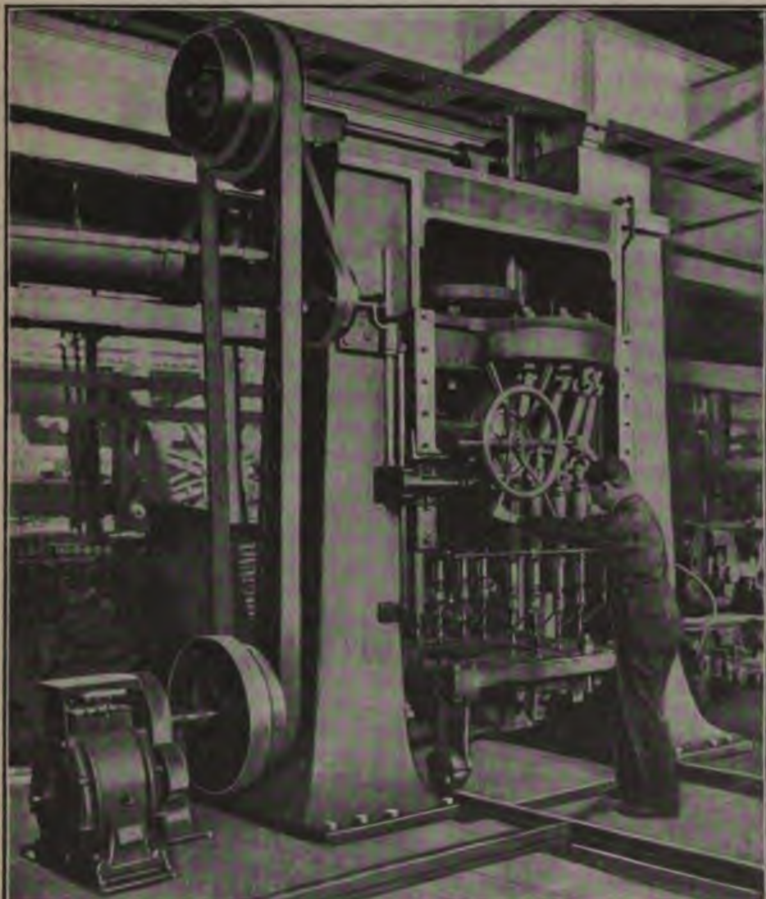


Fig. 2. Example of Jig Work with Motor-driven Multiple-spindle Drill.

Fig. 3. Method of Attaching Motor to Small Boring Mill.

The view given in Fig. 5 shows a Bausch Machine Company's radial drill driven by a motor of the same type. In this case the motor is mounted on the floor and belted to the countershaft. The casting being drilled, is the bedplate for a 2,250 K. W. (3,000 H. P.) railway generator for the St. Louis Transit Company. Fig. 6 shows a small boring mill in section F driven by a type C motor in the same manner as the radial drill. In this case, however, the variations of speed are obtained by a Reeves variable-speed countershaft instead of stepped cone pulleys. Fig. 3 is a small boring mill driven by a motor which is mounted on the machine itself and geared to it without the intervention of belts. Fig. 7 shows a motor-driven hydraulic press, a combination which is very neat and effective. In Fig. 8 is shown one of a group of Ingersoll milling machines used on street railway motor frames. In this case there are apparently only two changes available by means of the nest of four gears between the motor and the machine. Of course, on

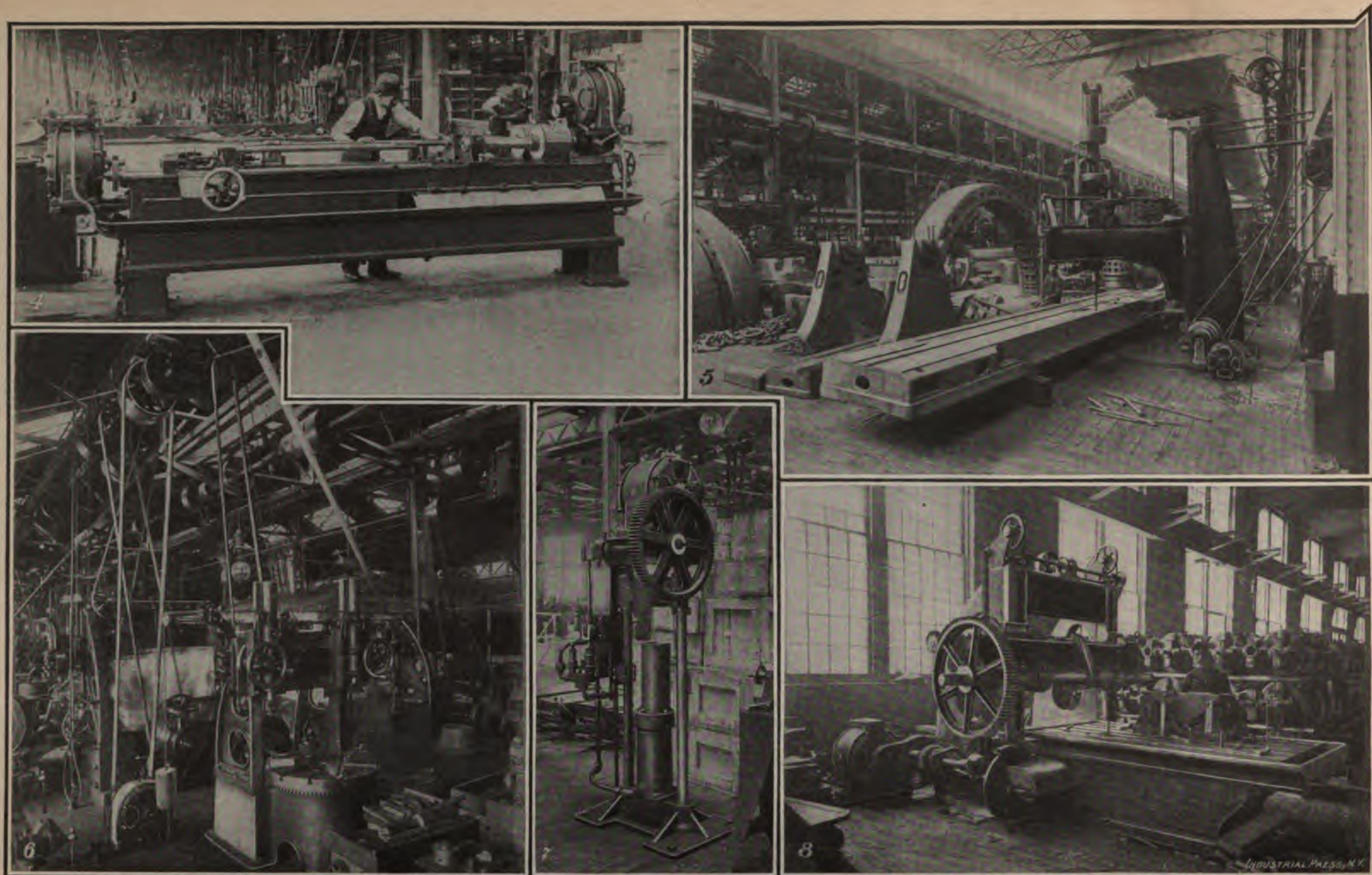


Fig. 4. Pratt & Whitney Horizontal Tube Drilling Machine.
Fig. 6. Constant-speed Motor with Variable-speed Countershaft driving Boring Mill.

Fig. 7. Hydraulic Press driven by Motor.

Fig. 5. Large Radial Drill at Work on Sub-base for Electric Generator.
Fig. 8. Method of Attaching Motor to Horizontal Milling Machine.

ELECTRICALLY-DRIVEN TOOLS.

these machines and with the class of work on which they are employed there is no need for a great range, since cutters of approximately the same size are always used. The Pratt & Whitney multiple-spindle drill, Fig. 2, also used on street railway motor work for drilling the frames, is driven by a polyphase induction motor geared directly to the shaft of the cone pulley at the base. The motor frames to be drilled are bolted to the under side of a four-wheeled jig which runs on a track between the columns of the drill. The jig thus performs the double function of a jig and of a car for carrying the frames to and from the drill. A number of these jigs are provided, and a helper is employed in bolting the frames in position while the machine operator is drilling them. A turntable is provided in front of the machine so that the jigs are turned one-fourth way around when opposite it and then run into position. The scheme rail and for that reason this tool, which was required to be of extraordinary strength, was built with the non-adjustable housings. The weight of the crossrail with the two tool slides alone is given by the makers to be 110,000 pounds, a weight equal to that of the heaviest locomotives of only a few years ago.

It is shown with a field magnet ring on the table for one of the 5,000 K. W. (6,700 H. P.) polyphase alternating-current generators for the new 75th St. station of the Manhattan Elevated Railway, New York. It will be observed that the ring is made in four pieces held together by links. The ring is secured to the cast steel hub by built-up steel disks similar to steel plate flywheels. It will run at 75 turns per minute, which gives it a peripheral velocity of 7,538 feet per minute, a speed beyond the safe limits of cast iron, but well within the safety limit of the steel disk construction.

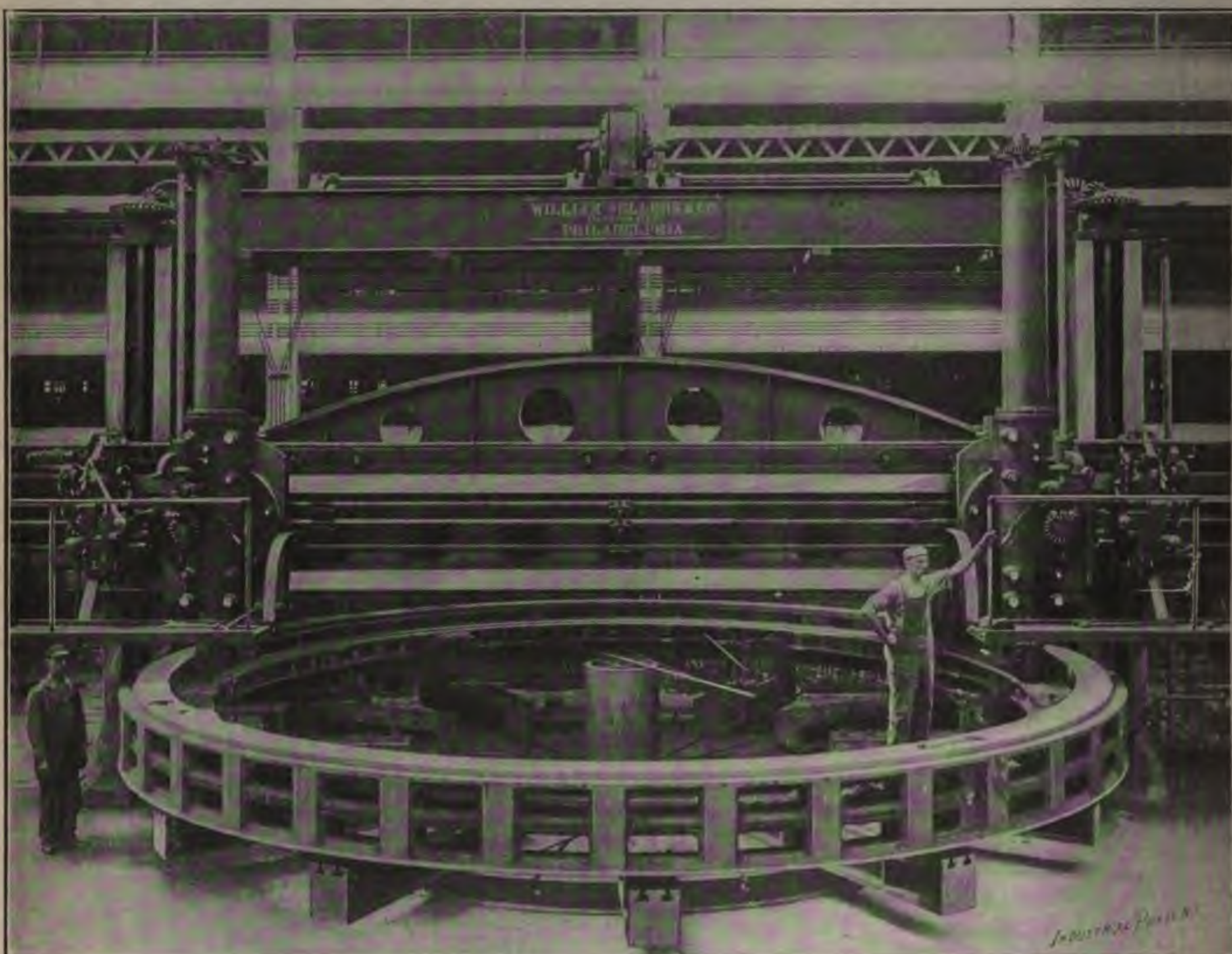


Fig. 9. Motor-driven Sellers Boring Mill. Swings 28 Feet, with Non-adjustable Housings. Cross-rail with Tool Slides weighs 110,000 Pounds.

is one which seems to work well in practice, as it enables the frames to be drilled rapidly and changes made with little lost time.

In many respects the most notable motor-driven tool seen is the 28-foot Sellers boring mill illustrated in Fig. 9. It is driven by a polyphase induction motor through a Reeves variable speed device. The motor and variable speed device are located beneath the shop floor and are covered over by trap doors which, when closed down, leave a clear floor space all around the machine. This boring mill is believed to be with one exception the largest non-adjustable housing machine built in this country. The Union Iron Works, San Francisco, Cal., have a 30-foot mill of entirely different design, but of the stated capacity between the housings. Other boring mills having so great a capacity obtain it by moving the housings back and using an extension tool slide when facing and boring the hub of a wheel requiring the full capacity of the machine. Such a construction is necessarily weaker than one which carries the tools directly on the cross-

It should be stated that the addition of the field magnets to the ring increases its diameter to 32 feet.

The hub for one of these generators is shown in Fig. 13 on the table of a Niles 16-foot boring mill. The hub alone weighs 48,000 pounds. It is a mild steel casting made by the Benjamin Atha & Illingsworth Company, Newark, N. J., having very nearly the same physical characteristics as pure iron. The total weight of the completed revolving field is over 330,000 pounds and of the complete generator about 880,000 pounds. The yoke mounted on its base stands about 43 feet high and gives the traveling cranes very little clearance when erected.

The machining of such large and heavy masses of metal has worked a great change in machine shop methods, and has led to the development of the floorplate system which may be seen in these shops in a highly developed state. It is with the floorplate system of manufacture that the traveling crane has achieved its greatest triumph and made possible methods which before its introduction were impossible and

scarcely thought of. For serving this section three traveling cranes built by the Morgan Engineering Company are provided. The main floorplate is 46 feet wide by 172 feet long, made up of cast iron sections about 8 feet square, which are laid with the greatest possible accuracy. The joints are barely perceptible to the eye, and it is quite safe to say that the total error in its alignment is probably not greater in proportion to its size than in the average large planer platen. Whether this is the condition when great weights are centralized on it the writer is unable to say, but some of the results ob-

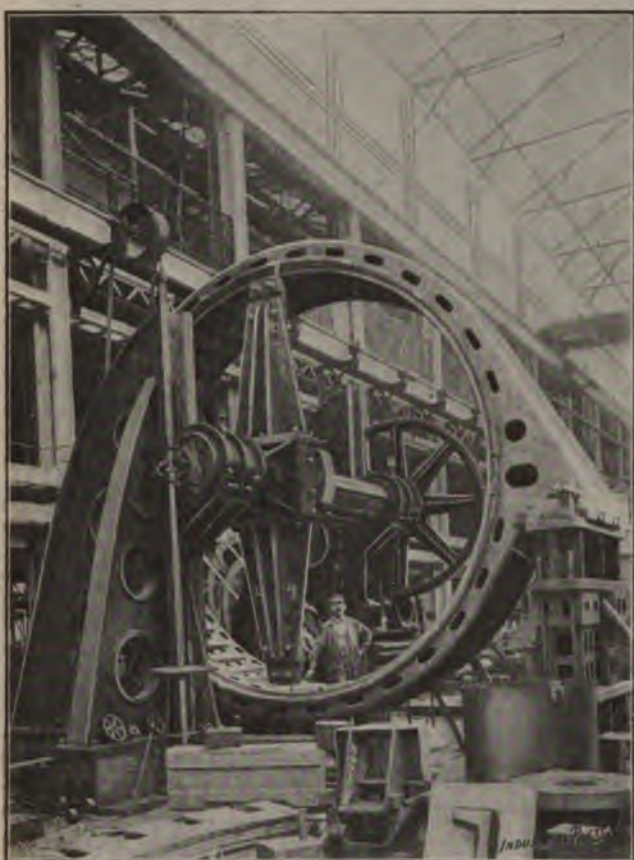


Fig. 10. Boring Yoke of Large Stationary Armature.

tained from machines working on it show that it must remain remarkably level and support heavy castings with very little deflection. For instance, the construction of the Manhattan generators requires laminated armatures made up of thin sheet iron punchings of approximately the shape shown in Fig. 16. These punchings have dovetails *A A A* which engage with similarly shaped dovetail grooves cut across the inside face of the armature yoke, as shown in Fig. 14, which shows a Morton draw-cut shaper mounted on a revolving counterbalanced arm and cutting them. These punchings overlap so that there are no continuous joints across the face of the laminations except at the joints of the yokes. They must exactly register at the holes *B B B*, etc., through which pass the insulated copper bars constituting the armature "winding." It is evident that the punchings must be of

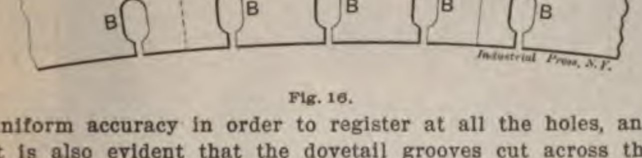


Fig. 16.

uniform accuracy in order to register at all the holes, and it is also evident that the dovetail grooves cut across the inside face of the yoke must be of equal accuracy. As stated this work is done on the floorplate with a portable shaper and is done accurately, as evidenced by the uniformity of the register of the holes for the windings.

Another interesting feature connected with the building of the Manhattan generators is the manner of turning the end plates which cover the sides of the armature laminations. These plates require to be turned on a radius of 18 feet or a circle 36 feet in diameter. It is done on a Niles mill having adjustable housings. The table is built out to the required capacity and a track provided of about the same diameter. The arms from the table carrying the ring to which the generator plates are bolted for turning are supported on this track by adjustable shoes which carry the weight, instead of the table.

The generator yoke boring machine shown in Figs. 10 and 11 is belt-driven from the line shaft at the side of the floor. The countershaft is located in a pit at the side of the machine shown in Fig. 11, and motion from it is transmitted by the vertical splined shaft. This shaft drives a horizontal worm through bevel gears, and the worm in turn drives a worm wheel and pinion which gears into the large spur wheel on the boring bar. It will be noticed that the housings are braced in two directions to take the torsional stress when boring and both the torsional and lateral stresses when

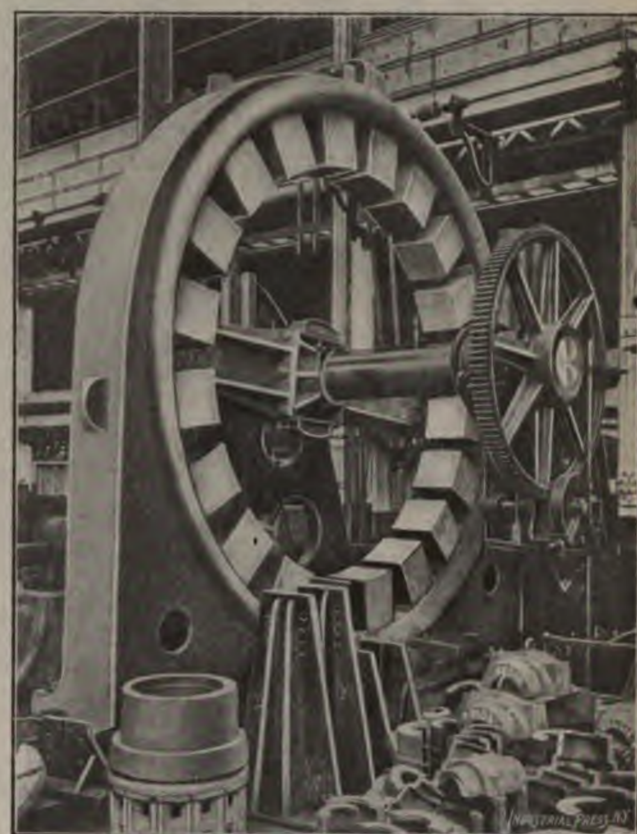


Fig. 11. Boring Field Frame of 2700 K. W. Generator.

facing the sides of the yoke. The yoke shown in Fig. 10 is for a stationary armature generator, and Fig. 11 is one having stationary field magnets. The field magnets are of laminated construction, built up in the sheet metal department. They are set in the mould in the foundry and the metal poured around them, thus uniting them to the yoke in a permanent manner, which gives the least possible magnetic resistance between poles. The immensity of this tool when boring the largest yokes may be better imagined than described. It will, of course, be appreciated that it is necessary to bore these yokes in the position which they are to ultimately occupy, as the deflection due to the weight of such great masses would flatten a circle bored on a boring mill to an ellipse and thus necessitate such a large air gap clearance as to greatly reduce the efficiency of the generator.

The building of commutators for such large units as are being installed in the power station of the Boston Elevated Railway is a most difficult job, as will not be denied when it is considered that for these generators the commutators are fully ten feet in diameter and made up of 1,080 copper segments which must be bored with the insulation in place between the segments. Such a piece of work is a triumph of mechanical skill and arouses the wonder of the experienced machinist and cannot fail to excite his admiration. Some idea as to the extent of the manufacture of electrical appara-

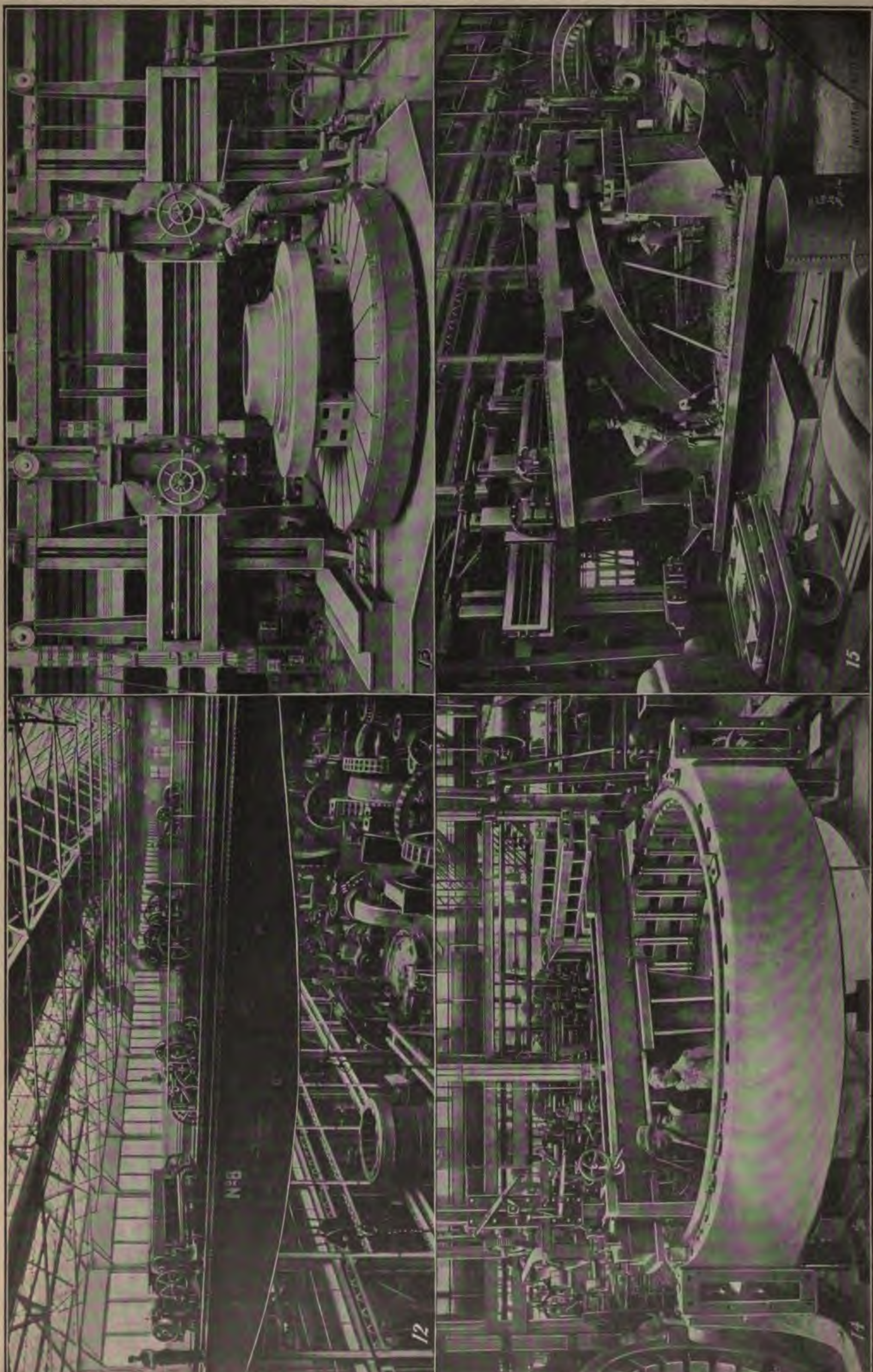


Fig. 12. Group of Cranes in Section of Machine Shop.
Fig. 14. Morton Draw-cut Shaper Cutting Slots in Generator Yoke.

Fig. 13. Niles Boring Mill turning Revolving Field Hub (48,000 Lbs.) for Manhattan Generator.
Fig. 15. Planing Bottom Section of Manhattan Generator Yoke. Total Weight of Generator, 890,000 Lbs.

tus in this establishment may be gained when it is known that more than forty tons of copper are daily used in the construction of parts of which the commutator just alluded to is an example.

Many interesting mechanical devices were observed in the other departments, some of which pertain to processes out of the immediate scope of the machine shop, but which show the wonderful developing effect the manufacture of electrical machinery is having on general machine shop conditions and practice. These devices and schemes also illustrate some of the problems which are daily being solved by the intelligent machinist or his big brother, the mechanical engineer.

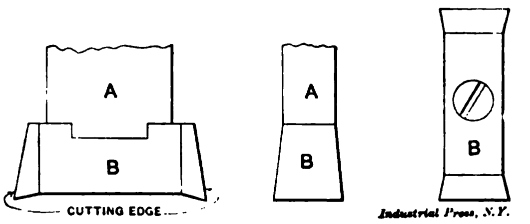


Fig. 17.

In one of the departments devoted to the manufacture of small parts are a number of small Pratt & Whitney slotters used for slotting out the rectangular holes in carbon brushes. These slotters are provided with a turret head carrying four tools, any one of which may be indexed to working position as required. The machines were extremely effective on the work named. The slotting tools are shaped about as shown in Fig. 17, and both the roughing and finishing tools are alike except that the finishing tool is, of course, enough wider to remove the roughing cut. The brush holders are clamped into a simple jig holding two brushes at once. The holes are machined with great rapidity. The scheme, of course, is to make both of the narrow sides of the slotting tool cutting edges so that reversal of the tool is unnecessary. The elements of the arrangement are not at all new, but the combination struck the writer as being about as effective a scheme for the purpose as ever noticed.

Shop blueprints are mounted on very heavy paper board probably one-fourth inch thick. The advantages of the practice are that the blueprints are always flat, or nearly so, and that they do not become torn. The paper board backing stands a great deal of abuse without damage, and is light to handle. While some of the workmen show a proneness to use them as lunch counters at the noon hour, which practice does not materially improve their appearance, the average life of a blueprint thus mounted is easily much greater than when carried into the shop without mounting, and they are much more convenient for reference.

It would naturally be concluded that a manufacturing establishment of the size and scope of this one must have a most systematic scheme for getting work through the different departments, and, of course, such is the case. In the manufacture of the large machines the castings are brought in at one end of the shop, and proceed toward the other end as they are machined. The smaller parts necessary for assembling meet the larger parts near the center, and are there assembled and loaded onto railway cars which are run directly into the erecting shop. This plan is generally followed throughout—that is, to have each part to follow a certain definite path through the works and to avoid passing two or three more times through any department. The cost of manufacture is reduced to lowest terms by avoiding unnecessary transfers and delays and by the general use of all labor-saving appliances which have been demonstrated to be such.

* * *

The lost art of hardening copper has been an attractive subject for many inventors and experimenters. It is extremely doubtful that the hardened copper tools of the ancients were nearly as efficient as we are asked to believe. They were probably surface hardened by being exposed to the fumes of some metal such as zinc or tin. It is claimed that copper may be hardened superficially in this manner. Copper mixed with tin in equal parts make the well-known specula metal which approaches steel in hardness.

THE VALUE OF HUMIDITY IN HEATING.

The real importance of the part that humidity of the atmosphere plays in heating systems is a subject of which little is generally known, or, at least, one to which little attention is paid. The amount of heat that is necessary for personal comfort is directly controlled by the percentage of humidity of the air, and if it were possible to control the humidity, heating might be accomplished much more easily than under present conditions.

A valuable paper, on the subject of "School Room Temperature and Humidity," which was recently read by Mr. William George Bruce, before the Department of School Administration, Detroit, Mich., and referred to at length by the *Scientific American*, touches upon this subject very clearly and is worthy of consideration, since it bears upon the conditions existing in any building occupied by human beings.

The author treats of the subject of atmospheric humidity, or air moisture, in relation to indoor heating. This element in the problem of artificial heating has never received the measure of attention which its importance demands. It is a well-established, though too little known, fact that the degree of heat which is necessary for comfort indoors is directly related to the percentage of humidity of the air. We who live in New York know by bitter experience that a summer temperature which is comfortable when the percentage is low, becomes insufferable when that percentage is high. This is explained by the fact that when the air is dry, evaporation from the body is rapid, and the latent heat of evaporation, being drawn from the body, cools it off proportionately. When the atmospheric humidity is high, the air is less able to receive fresh moisture, evaporation from the body is slow, and its temperature is correspondingly high. Applying this to the low temperature of the winter season, we find that the very dry air of many houses conduces to a rapid evaporation from the human body, and a corresponding lowering of its temperature. Hence the interior of a house in which the air is abnormally dry must be at a higher temperature to be comfortable than an interior in which the percentage of humidity is high.

Speaking upon this question, Dr. W. M. Wilson, of the United States Weather Bureau, who has given the subject careful study, says: "It is safe to assume that during the winter months the normal relative humidity in lake cities is 72 per cent. From observations with respect to moisture in business offices and living rooms heated by steam, hot water and hot air, it is safe to assume that the average relative humidity in artificially heated dwellings and offices in the winter months is about 30 per cent, or about 42 per cent less than the average outside humidity, and drier than the driest climate known."

As the evaporative power of the air at a relative humidity of 30 per cent is very great, the tissues and delicate membranes of the respiratory tract are subjected to a drying process and a great increase of work is placed upon the mucous glands in the effort to compensate for the lack of moisture in the air. This increase of activity, and the frequent unnatural stimulation induced by the changing conditions of humidity from the moisture-laden air outside to the dry temperature inside of our dwellings, result in an enlargement of the gland tissues and a thickening of the membrane itself.

It has been stated by engineers who have given careful study to the subject that by holding the temperature of our school rooms, living rooms and offices at 60 degrees and raising the humidity to 70 per cent, about 25 per cent of the cost of heating might be saved. It is suggested by Dr. Wilson that to avoid the possibility of unpleasant results from condensation, our dwellings could be heated to 65 degrees with a relative humidity of 50 per cent and a saving of from 12½ to 15 per cent secured over the present cost of heating.

This interesting paper naturally raises the question as to whether humidity can be brought under proper mechanical control. That is to say, can atmospheric moisture be supplied artificially and accurately to the extent that may be desired? This is a field of research and experimentation in which some good results have been achieved, but which is yet open for considerable improvement.

NOTES ON THE TAYLOR-WHITE PROCESS FOR TREATING STEEL.

In the September number of the *Journal of the Franklin Institute* is published a paper by Charles Day upon the Taylor-White process for treating tool steel and the results obtained with steel so treated at the works of the Link Belt Engineering Co., Philadelphia, Pa. When this process was first announced we gave a few facts about it and quoted reports of tests made at the works of the Bethlehem Steel Co., Bethlehem, Pa., where the process was developed by Messrs. Taylor and White. The paper by Mr. Day gives information upon air hardening steels in general before reverting to the subject of steel treated by the Taylor-White process.

Mr. Day says that air-hardening steels have unquestionably replaced the carbon variety for roughing work, the efficiency of the former ranging from one and one-half to twice that of the latter. This gain is because air-hardening steels hold their cutting edge at much higher temperatures than carbon steels and consequently can be worked at proportionately greater cutting speeds. The usual method of hardening air-hardening steels is well known, manufacturers usually placing great stress on the fact that the tool must not be heated above a cherry red, otherwise it will be burnt and so ruined. The object of Messrs. Taylor and White was to obtain some exact knowledge on this matter and extensive experiments were conducted in the belief that a tool steel could be produced to give still better results than those already obtained.

The new process depends upon the fact that although both carbon and air-hardening steels deteriorate rapidly when the temperature rises above a cherry red, there are some chemical compositions that may be used for air-hardening steels which are much improved as cutting tools if they are raised to a higher temperature in the hardening process. Their maximum efficiency is reached when the steel is heated to a point where it crumbles when tapped with a rod. The point at which air-hardening steels were formerly heated in the process of hardening is between 1,500 and 1,600 degrees F., and is called the breaking-down point. Steel having the new treatment is heated to 2,000 degrees F. The composition found to give the best results consists of an air-hardening steel containing about 1 per cent of chromium and 4 per cent of tungsten; while for very hard metals, such as the chilled scale on cast iron, etc., 3 per cent of chromium and 6 or more per cent of tungsten are good. The variation in carbon seems to matter but little, steel varying from 85 to 200 points giving equally good results.

The tool is cooled rapidly from the "high heat" (2,000 degrees) to a point below the breaking-down temperature in a lead bath, and then slowly in the air, or lime, etc., as the case may be. It is essential that at no time the temperature should rise, as in such a case the tool would be seriously impaired. After the steel has cooled off, its efficiency is found to be further increased by subjecting it to what is termed the "low heat" for about ten minutes; this temperature ranging from 700 degrees F. to 1,240 degrees F. After cooling from the "low heat" the tool is ready for use. It is not essential to anneal the steel when reforging and the tools can be worked with comparative ease.

In the operation of the Taylor-White process apparatus is employed by means of which temperatures can be controlled within very narrow limits, which accounts for the uniformity of results obtained with the tools treated by this process.

About 97 per cent of the material worked upon at the shops of the Link Belt Engineering Co. is cast iron. In order to make a rough test on cast iron one tool was obtained from Bethlehem and put to work on a 7-foot boring mill turning the inside of a cast-iron ring. The time required to do this work with their old tools had been determined many times in setting piece rates, and was about fourteen hours. With the Taylor-White tool this time was reduced to three and one-half hours, and a gain of 75 per cent made. While the steel used heretofore was not the best obtainable, and was probably not worked to its highest efficiency, there was, nevertheless, a large saving due to the new steel.

Some interesting data was also obtained from an order of rope sheaves, the time required to do similar work having been tabulated for several years. The average time required to machine thirteen sheaves with the old tools was nine and one-half hours; the same for sixteen similar sheaves, the roughing being done by Taylor-White tools, was five hours and five minutes, or a saving of 46½ per cent.

Assuming, however, the time for setting up, forming, boring and polishing the same when the sheaves were finished with old tools as with the treated tools, since the latter are not suitable for finishing cuts, the time for roughing would have been 7.85 hours and a saving of 56.3 per cent was made in operations where it was possible to use treated tools.

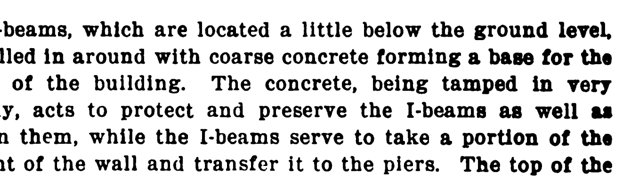
In order to obtain some data with regard to pressure on the points of tools for given depth of cuts, feed, etc., and at the same time to show the effect of the treatment, a cast-iron ring six and one-half feet in diameter was bolted to the table of a seven-foot mill. The first tool used was one treated for hard material. It cut 106 pounds of metal in 10 minutes, and when removed was in perfect condition. A "Mushet" tool under the same conditions lasted but one minute, and removed 5½ pounds of metal. The actual pressure against the tool in each case exceeded 3¼ tons, while the pressure per square inch with another self-hardening tool was 143,000 pounds.

Eighteen months ago a 50 horse power engine supplied the power to about 40 machine tools in the Link Belt Engineering Co.'s works, and also ran the pattern shop and grinding room. The actual horse power developed had been found to average 45. Of this 27 horse power was consumed by the shafting, leaving but 18 horse power for actual work. After the new tools were in general use and the machines pushed to obtain the desired results, it became apparent that the power was absolutely inadequate; indicator cards from the engine frequently showed an overload of 60 per cent, and at this point it was found essential to put motors on some of the larger tools.

* * *

A BUILDING FOUNDATION.

In the construction of the new machine and erecting shop, which is being built by the Waterbury Farrel Foundry and Machine Co., Waterbury, Conn., a novel foundation is being used. A heavy traveling crane is to be used in the shop and extra heavy foundations are being provided to support the crane tracks, which involve an interesting departure from usual methods. At the particular location of this shop, bed rock is found about eight or ten feet under the surface. Holes were dug on the wall lines down through the soil, about 12 feet apart, to get a bearing upon the rock and brick piers, about four feet square, erected in the holes upon the rock bottoms, as shown at *P P* in the accompanying diagram. These piers are made to serve as bearings for steel I-beams, shown at *I I*, which are of lengths corresponding to distances between pier centers, and are placed upon the piers end to end. Then



Industrial Press, N.Y.

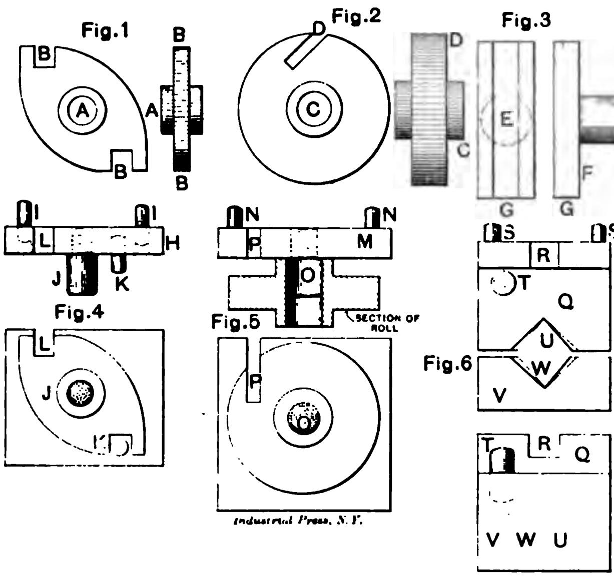
the I-beams, which are located a little below the ground level, are filled in around with coarse concrete forming a base for the walls of the building. The concrete, being tamped in very solidly, acts to protect and preserve the I-beams as well as stiffen them, while the I-beams serve to take a portion of the weight of the wall and transfer it to the piers. The top of the concrete, when dry, is ready for the wall of the building. The level of the top of the concrete is to be the level of the bottom of the cement floor. This foundation will thus be practically equivalent to starting the entire wall from the bed rock level, with, however, considerably less expense, and it is expected that it will be a very durable and lasting construction.

TOOLS FOR INTERCHANGEABLE MANUFACTURING.—5.

ILLUSTRATIONS OF SIX DISTINCT TYPES OF MILLING FIXTURES.

JOSEPH VINCENT WOODWORTH.

Having in the four preceding articles described various types of fixtures and tools suited for machining different grades of duplicate work by drilling, we will now turn our attention to milling fixtures, and will devote this paper to those adapted for machining the simpler grades of work in



Simple Fixtures for Simple Pieces.

which no great accuracy is required, but in which, at the same time, it is necessary to produce to a certain degree of interchangeability.

In the construction of tools and fixtures for the machining and duplication of interchangeable machine parts by milling, a number of obstacles must be overcome that are not met with in the fixtures or jigs described in preceding articles. There are also a number of practical points in their design and construction which are absolutely essential to their successful operation, the conditions under which they are operated being totally different from those under which drilling jigs and fixtures are used. It does not require as high-grade skill to construct fixtures for accurate milling as for accurate drilling, yet the designing of these fixtures entails considerably more thought and practical ability, to give satisfactory results. In Figs. 1, 2 and 3 are illustrated three

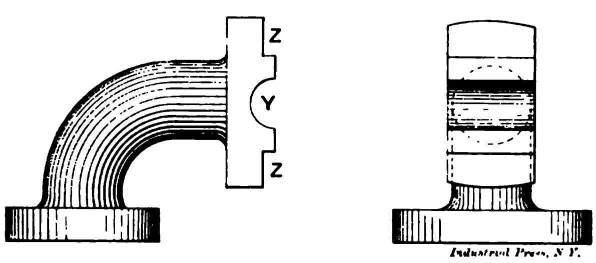


Fig. 7

samples of work milled by the use of inexpensive fixtures which may be aptly termed "emergency fixtures." The fixtures are shown in Figs. 4, 5 and 6. The design and method of construction are very simple, and are clearly shown in the illustrations. The fixture for milling the square channel at *B B*, Fig. 1, is shown in Fig. 4. It consists of a square plate *H* of ⅝-inch flat machine steel, finished all over; of the central locating stud *J* screwed tightly into the center of the plate; of the end locating pin *K*, and of the two dowel pins *I I*, which coincide with two holes drilled and reamed to size in one of the steel jaws of the miller vise. The channel *L* is used as a guide for the cutter, and also as a gage for the depth and location of the cut in the work. This fixture is located on the inside of the vise jaw by the dowels *I I*, and the stud *J* is entered into the reamed hole *A* of the work, and one side of the rough cast channel *B* set against the locating pin *K*, as shown. The vise is then closed and tightened against the work and the cutter is set to enter the guide channel *L* of the fixture, so that it will just touch the bottom of it. One end of the work is then milled; then the work is reversed on the fixture, so that the finished channel will locate against the stop pin *K*, and the other end is finished.

The other two fixtures shown in Figs. 5 and 6 are also constructed to locate on the stationary jaw of the miller vise. That shown in Fig. 5 is relatively the same as the first, except that no stop pin is required—the work, Fig. 2, being round and having but one slot *D* milled in the position shown. The hubs of the work are faced and the hole *C* is reamed to size, the outside being finished to a given diameter in the lathe before milling. Fig. 6 shows a fixture used for milling the channel in the face of Fig. 3. It is in two sections, *Q* and *V*, the inside or face of each being finished in the form of a V, as at *U* and *W*, respectively. These sections are of cast iron. The largest one *Q* has a raised projection at one end with a guide channel *R* milled central with the V on the face. *S S* are the two vise jaw dowels, and *T* the sideway locating pin for the work. Both these fixtures are operated in the same manner as that shown in Fig. 4, and are adaptable for milling a large variety of small machine parts that are not required in large quantities, or in which a given limit of error is allowed, thus necessitating the utmost economy in the expense of the fixtures for their duplication. The efficiency and practical value of these three fixtures are at once apparent.

Fixtures for Milling a Bearing in a Bracket.

A plan and a side view of a simple fixture that can be adapted for odd-shaped castings are illustrated in Fig 8. This fixture is used for milling the bearing and cap surface of the bracket, Fig. 7, to the shape shown at *Y* and *Z Z*

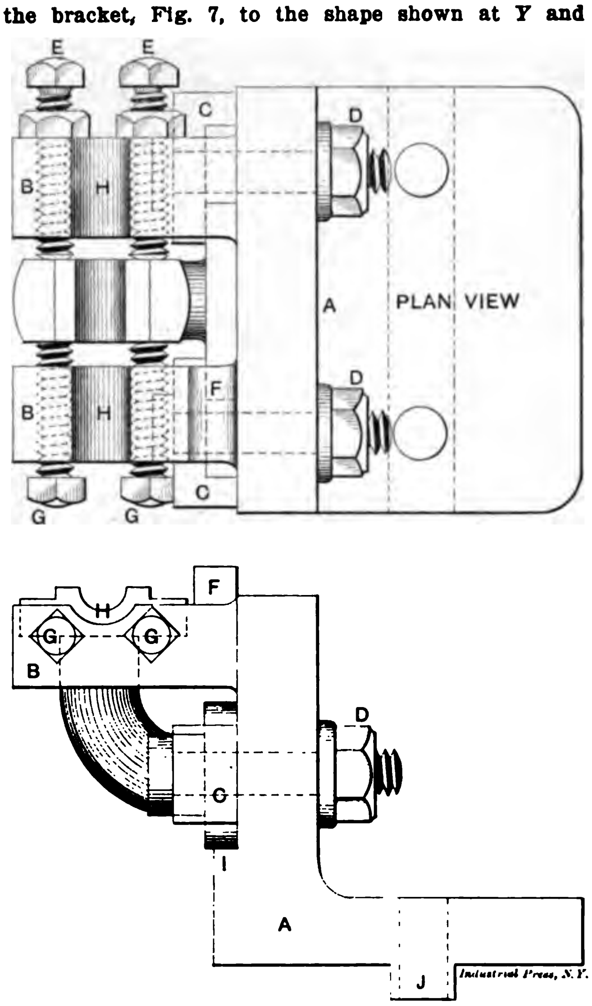


Fig. 8. Plan and End View of Fixture for Holding Bracket shown in Fig. 7.

respectively, the bearing *Y* being milled to an exact half-circle of the radius required, so as to conform with its duplicate in the cap. This is afterward fastened to the bracket and the bearing reamed to the finish size. The fixture consists of one main casting in the form of an angle

plate. When the base has been finished, the tongue *J* fitted to the central slot of the miller table, and the two holes drilled for the fastening bolts, the angle plate is set up on the miller, facing the spindle. The face is then milled, ending in a square shoulder at the locating surface *I*. The two clamps *C C* are then made, and holes drilled in the face

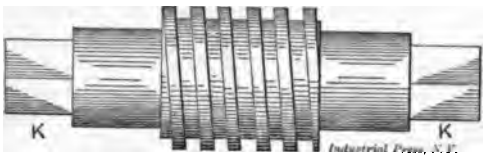
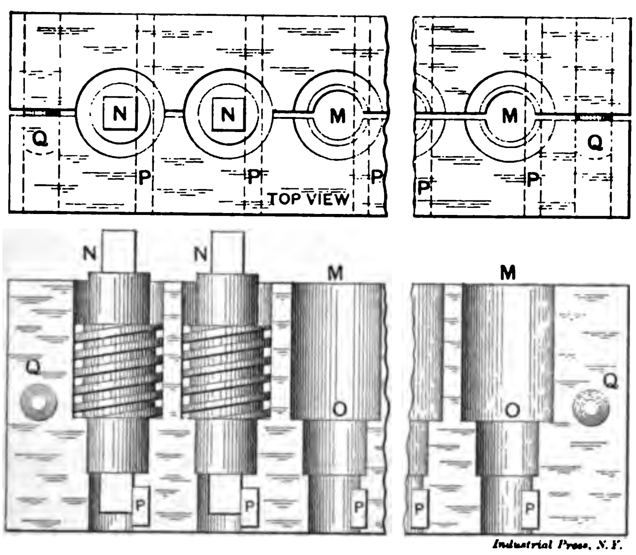


Fig. 9.

of the angle plate to admit their bolts *D D*. Locating set screws *E E* are then let into the back extension lug *B*, and fastening screws *G G* let into the front lug, as in plan view, Fig. 8. Both views of the fixture show clearly the manner of locating and fastening the work on the fixture. With the use of this fixture one can rapidly locate and fasten the work, the clamping arrangements insuring the rigidity of the work when presented to the cutter. As will be seen, there is a projecting surface *F* at the top of the front extension lug; the face of this lug is milled square with the face of the fixture, and acts as a gage point for setting the gang mill the proper distance from the locating face of the fixture. Fixtures of this design should be used wherever possible, as the small number of parts and rapid handling commend them.

Fixture for Use in Squaring the Ends of Duplicate Pieces.

Fig. 10 gives two views of a milling fixture which is (to the best of my knowledge) new in design, and has possibilities for a wide range of work of the type shown in Fig. 9. This work is a square-threaded screw with duplicate ends. The ends were required to be squared so as to be exactly in line with each other, as shown at *K K*. The



SIDE VIEW OF ONE HALF OF FIXTURE

Fig. 10. Fixture Used in Squaring the Ends of Pieces shown in Fig. 9.

fixture is constructed to accommodate six screws at a time, and is made in two sections, Fig. 10. These sections are of cast iron, finished and squared all over, and doweled together by pins *Q Q*, one at either end. The spacing, locating and finishing of the six work receivers—two of which are shown with the work *N N* in position—is accomplished in the milling machine by means of a special counterbore. This finishes them so that a perfect half-form remains in each section, with the shoulder of each at *O*, exactly the same distance from the top of the sections. A cut is then taken off the face of each section so that the work may be clamped securely. The most interesting feature of this fixture is the manner of locating the work within it so that the second operation of squaring the ends will be accomplished with ease and expedition. This is done by milling a slot crossways through the bottom of the sections at the side of each receiver to accommodate the locating plates *P P P P P P*, as shown. These slots or channels are so finished by the use of graduated dials on the table feedscrew of the Universal miller that when the plates *P* are driven tightly into one of the sections, and extending into the other (the slots in which must be slightly enlarged to allow of them entering freely), one of the squared sides of the end of the work will rest squarely against them. When in use the six plates *P* are first removed and two sides of one end of the work milled with a gang cutter. When all have been treated in this manner the six locating plates *P* are again inserted in their channels, and the ends finished, requiring three more operations as follows: First, enter the end of the screw that has been milled, so that one of the sides rests squarely against the locating plate; then mill two sides of the other end at right angles with those milled on the first end. Now, by reversing the screws, the remaining two sides of the first end can be finished square with the other two. This operation is repeated and the ends

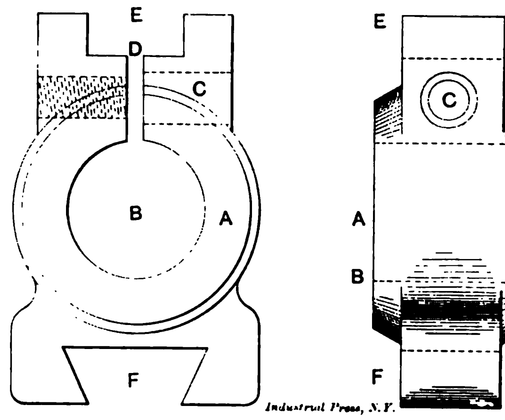


Fig. 11

again reversed, thereby finishing both ends square and exactly in line with each other. The use of this fixture enables duplicate parts of the work to be finished exactly alike, and, what is more, the squaring of the ends, which is usually a rather slow and difficult job, is thus accomplished with ease and rapidity.

Fixtures for Use in Slotting and Dovetailing Small Pieces.

Two examples of a somewhat different type of milling fixture are illustrated in Figs. 12 and 13. These fixtures are

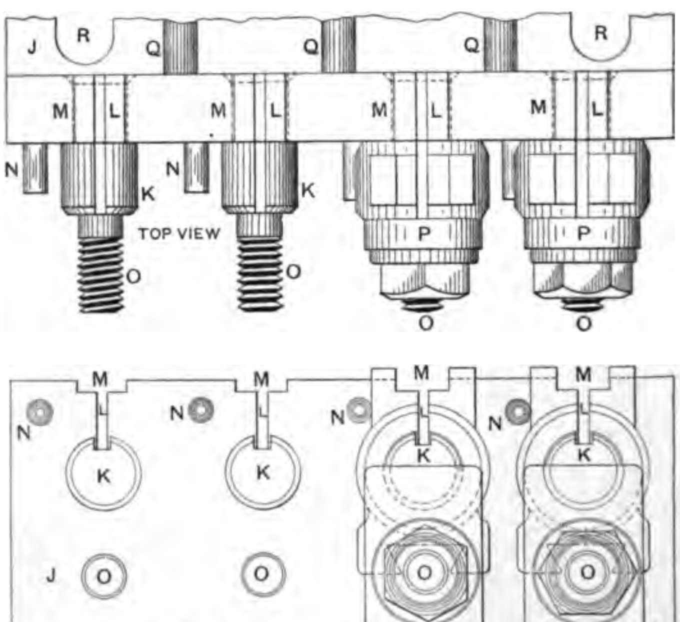


Fig. 12. Fixture Used in Slotting Piece shown in Fig. 11.

used for milling and duplicating the casting shown in two views in Fig. 11 and embody in their design a number of practical points which are suggestive. That shown in the two views of Fig. 12 is used to mill the square channel at *E* and the slot *D*, Fig. 11. The drawings clearly show the

method of construction. The work is located centrally on the stud *K*, and sideways against the stop pin *N*, the clamp *P* holding it tightly and securely against the face of the angle plate *J*. The guide channels *M M M M* are for the large cutter, and *L L L L* for the slotting cutter. The angle plate, or fixture proper, is well ribbed at the back, as shown at *Q Q Q*, and is located true on the miller table by a "feather" in the channel cut in the bottom. When used in conjunction with a set of gang mills this fixture is a very rapid and accurate producer. The guide-channels in the fixture enable one to set the cutters to take the proper depth of cut, and to locate them central with the hole *B* in the work, Fig. 11. When in operation the cut is against the fixture, thereby holding the work rigidly against its face.

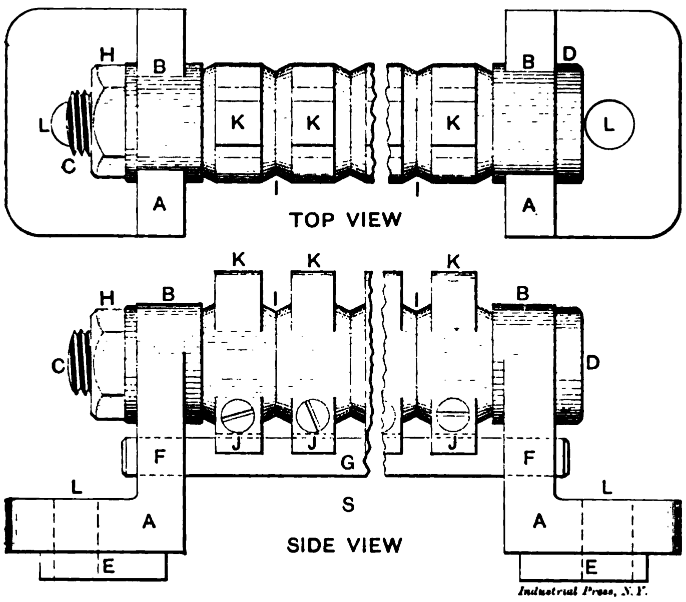


Fig. 13 Fixture Used in Dovetailing Piece shown in Fig. 11.

Fig. 13 shows two views of a fixture which, although very simple and inexpensive to construct, has much to commend it. It is used for milling the dovetail in the end of the casting shown in Fig. 11, and will accommodate six castings at a time. It consists of the two end angle brackets *B B*, the central locating and clamping arbor *C*, and the locating bar *G*. The end brackets *B B* are first bored out and the hubs faced, and then they are placed on an arbor and the base of each is milled with the tongues *E E* in line with each other. A square hole is now let in to the face of each bracket at *F*, as shown, and finished to size and in line by clamping both brackets together and forcing a broach through the unfinished holes. The locating bar *G* is of square tool steel finished all over for its entire length to fit nicely within the holes in the face of the brackets. The width of the bar is made to fit the square channels *E*, Fig. 11, previously milled in the castings or work. When the fixture is in operation the bracket *B*, at the right, is clamped securely on the miller table, and the one at the left slipped off the arbor *C*. The six castings *I* are then slipped onto the arbor with the square milled channel of each down, so that the locating bar *G* rests within them. The left bracket is then slipped on and the nut *H* tightened slightly. By tightening the screws in the ends *J* of the castings the channels are clamped to the locating bar *G*. Nut *H* is then tightened securely and the bracket firmly clamped to the table; and by the use of the vertical attachment and of an angular cutter the six castings are milled and finished to the shape shown at *F*, Fig. 11, and at *K*, Fig. 13. The points to be considered when designing fixtures for milling in one operation a number of small parts of the type here shown are as follows: First the number which can be handled to the best advantage; second, the manner of presenting the work to the cutter or cutters, and, lastly, the most expeditious and reliable means for locating and fastening the work rigidly while being milled.

Fixture for Use in Gang Milling.

A type of fixture used extensively for gang milling, where wide surfaces or a number of depressions are to be milled in the face of castings that have not been previously machined, is shown in Fig 14 Although of the simplest construction, it represents a useful type of milling fixture for the milling of a large variety of work that it would be difficult to machine rapidly by any other means. This fixture is used for the milling of the type of casting shown at *H*, Fig. 14, which consists of four channels *H H H H* in the face, and of the square channel *I* in one end, requiring two separate operations, both being accomplished on the one fixture. Fig. 14 shows a section of the plan and side view, and also an end view of this fixture which handles eight castings at once. It consists of one long casting *M* having two half-round depressions running down its entire length as clearance for the pro-

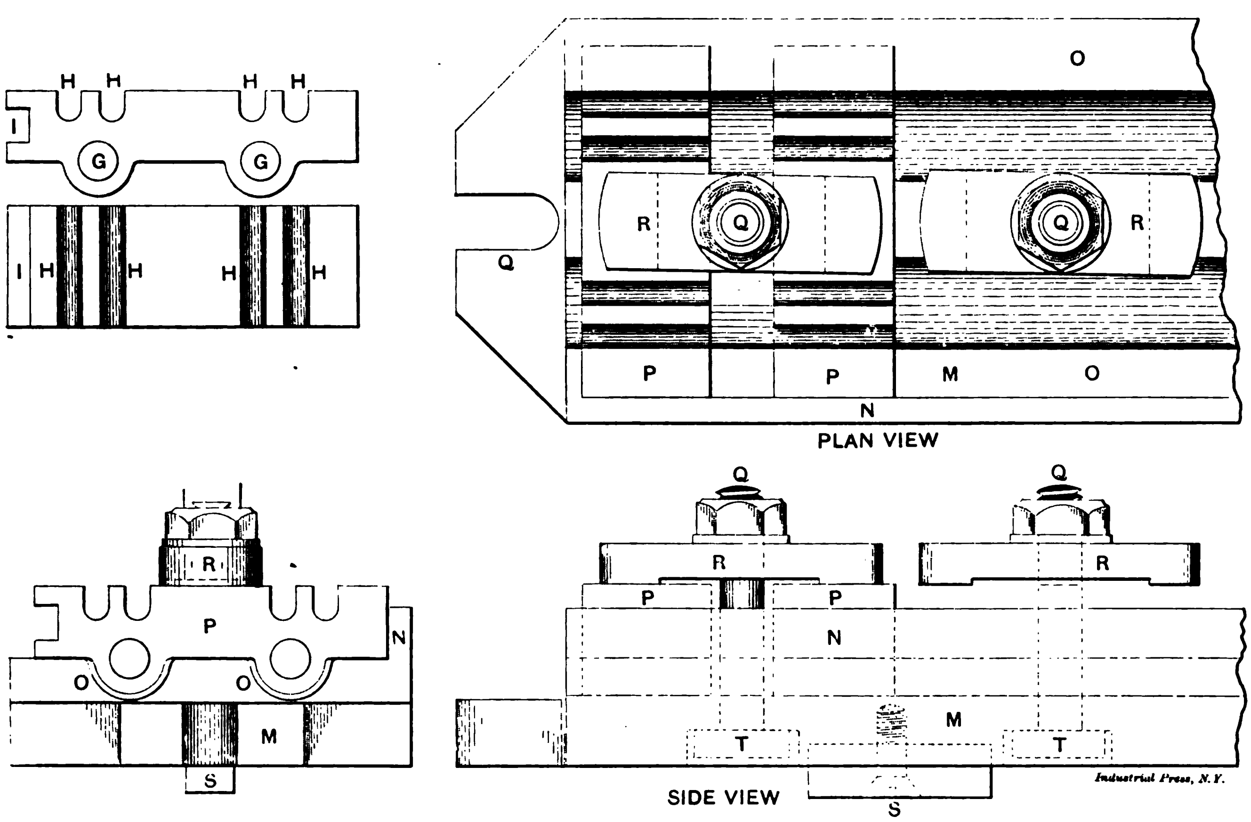


Fig. 14. Plan, Side and End Views of Fixture Used in Milling Piece shown in upper left-hand corner of this Figure.

jections on the back of the work. The top is planed true with the base as a squaring surface for the work, and ends in a square shoulder at N for the work to locate against. The work is held in position by clamps R R, so placed as to clamp two castings, as shown at P P. The holes for the bolts are counterbored at the back to allow the heads to clear the miller table, as at T T in the side view, Fig. 14. The work is fastened as shown, and the square channel in the end is milled. When all the castings have gone through this oper-

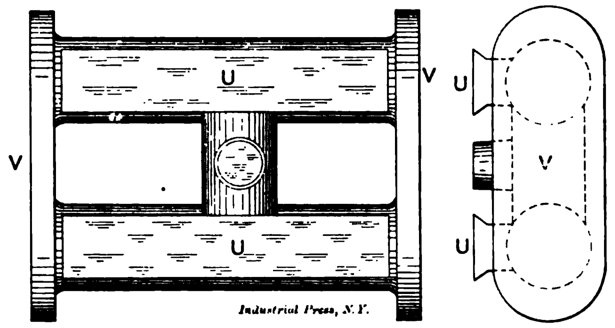


Fig. 15.

ation the four channels are finished by relocating and fastening the work to the fixture and setting a gang of mills; the cross slide of the miller table is then clamped, the depth of the cut set, and the castings finished.

Fixture Used in Face Milling.

Another type of simple milling fixture is shown in the two views of Fig. 16. Although somewhat similar to that shown in Fig. 14, it is used for a distinctly different class of milling; that is, face milling. The sketch shows it being used for both ends V V of a casting, Fig. 15. This casting is first set up on the planer and the dovetailed slide surfaces U U are planed to gage. The fixture is constructed to handle two castings at once, they being located sideways by forcing the side of one of the dovetailed surfaces Z against the angular faced locating lugs X X X X, as shown, and endways against the squared and faced projections Y Y at the back. The castings are held in position by two clamps each, as at C C C C, and the heads of the bolts are let into the base as at A A in the side view. The ends of the castings are faced by a large cutter holder, with self-hardening steel cutters set

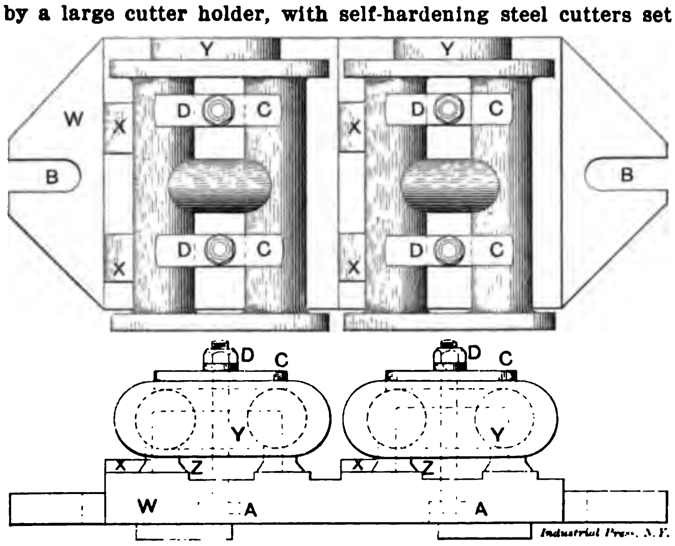


Fig. 16. Fixture Used in Milling the Ends of Casting shown in Fig. 15.

into the rim, so that a roughing and a finishing cut can be taken at the same time. When one end of the castings has been faced they are reversed, relocated, and the other end is then faced.

When the large variety of machine parts, both small and large, which can be machined in exact duplication of each other by the use of just such simple and inexpensive fixtures as are here shown is considered, it is surprising that these methods of manufacture have not been adopted more extensively. By this we mean in the small shop; for in the large shops—unless the machines or appliances are manufactured under patents—it is absolutely necessary to manufacture by the interchangeable system in order to meet competition.

ITEMS OF MECHANICAL INTEREST.

NOTES ON SHOP PRACTICE FROM VARIOUS SOURCES.

Instances are frequently noted where belt tighteners have been placed on the tight belt side of the pulleys instead of on the slack side, as they should be for any ordinary drive. Where the tightener is employed for temporarily driving a tool the result of placing a tightener on the tight side is that it requires a great deal of pressure to hold the tightener in place, whereas if it is on the opposite side very little pressure suffices to make the belt pull its maximum load. In the blacksmith shop of a railway repair shop there was for a number of years a Bradley hammer which afforded a good object lesson of the right and wrong position of belt tighteners and also incidentally illustrated the truth of the saying: "What is everybody's business is nobody's business." When erected no attempt was made to have the driving belt run in the right direction for the tightener, as it apparently was considered of little importance, since it made no difference with the hammer in which direction the crankshaft was run. As a result the tightener came on the tight belt side and to operate the tool it always required the services of two men, one to hold the work and the other to throw his weight on the footpiece operating the tightener. After some years a young machinist noted the way the tightener was applied and by making some small changes, reversed it so that it came on the slack side of the belt. The astonishment of some of the men over the improved working of the tool was only exceeded by their appreciation of the simplicity of the change and wonderment at why it had not been made long before.

MEASURING LARGE DIAMETERS.

It is not an easy matter to measure large diameters with accuracy. The spring and deflection of the measuring instrument, its awkwardness, and the difficulty of obtaining the exact length of the diameter in feet and inches after the measuring instrument has been set, make the operation a troublesome one. Suppose, for example, it were desired to place a second band wheel upon an engine shaft, the second wheel to be of exactly the diameter of the first one so that the belts could run from both band wheels to a single jack pulley without undue slipping. What would be the best way of securing the measurement? Some would use a measuring rod, with one end placed on the side of the shaft and the other end adjusted to come even with the surface of the pulley. Others would use a steel tape, passing it around the surface of the pulley on the circumference, and divide the reading taken by 3.1416 to get the diameter. We are inclined to think that the steel tape method is the best. A good steel tape is accurate and in civil engineering it is depended upon for extremely accurate results. When wrapped around a metal body it soon acquires the exact temperature of the body and there is no error from unequal expansion. It is strong enough so that it can be drawn tightly about the work, taking out the slack, and the only allowance to be made is for the thickness of the tape. Another advantage is that the reading is magnified just 3.1416 times, each inch on the diameter being represented by this number of inches on the tape, and the diameter can thus be estimated closely to within a small fraction of an inch. In a recent number of the *Iron Trade Review* F. O. Reman offers the suggestion that a steel tape be made specially for this purpose, with inches represented by divisions 3.1416 inches in length and the subdivisions in proportion. It may be added also that a cheap steel tape is entirely unreliable. In no other instrument do price and quality count for more than in a tape, and if one is to be used it should be an expensive one made by a reliable maker.

WET VS. DRY EMERY GRINDERS.

There seems to be still some question amongst good mechanics as to whether a dry wheel or a wet wheel is preferable for use in sharpening twist drills.

Expressions of opinion from mechanics whose names are well known indicate that they are divided in regard to this question. One of these gentlemen who is considered to be an authority on grinding machinery says that he would use

nothing but a dry wheel himself, but if he were manufacturing drill grinders he would build nothing but wet grinders to sell.

His idea seems to be that a person who understands how to use emery wheels properly, and to select the proper grade and grit for different kinds of grinding, can grind a drill just as well on a dry wheel as on a wet one with no risk of drawing the temper, but that the ordinary machinist who undertakes to grind a drill will get better results if the wheel is provided with a supply of water so that the temper cannot be started no matter how fast he tries to grind or how hard he crowds the drill against the wheel. It is true, however, that whatever difference of opinion may exist in regard to drills of small size, there is practically unanimous assent to the value of water grinding for grinding the large sizes of drills, ranging, perhaps, from 1¼ up to 3½ inches, or larger, in diameter. In the grinding of such drills there is so much metal to be ground off even if only a few thousandths in thickness, that the tendency to heat the drill is more marked, and thus the value of the water is the more apparent.

The great importance of never allowing the temper to be drawn the least particle in any part of the cutting edge of a twist drill is not sufficiently realized by the great majority of workmen. The outside corner of the cutting edge especially is one that is very liable to get heated in grinding, with the result that the drill soon wears tapering and then requires much additional power to drive it.

HOT BATH TEMPERING.

A novel method of steel tempering is being used in connection with the gas-furnace by certain manufacturers, whereby the temper to which the work is to be drawn is reduced to an absolute certainty. The crucible of a crucible-gas-furnace is filled with melted beef-tallow, and this tallow bath may be maintained at almost any temperature required for drawing tempers, as tallow is capable of taking very high temperatures. The temperature of the bath is determined by a suitable pyrometer, as Le Chatelier's electrical pyrometer, in which the temperature may be read at some distance from the furnace, and its temperature may easily be varied and regulated by adjusting the gas flame in the furnace. In this way the exact heat required to draw the temper the desired amount may be definitely obtained, which eliminates the element of guesswork from the process. For instance, if it is desired to draw the temper on milling cutters, or taps and dies, to their required straw-yellow temper, all that is necessary is to adjust the heat of the bath to about 460 degrees F., as indicated by the pyrometer, which is the temperature to which hardened steel must be drawn to give the straw-yellow temper, and then dip the pieces in which the temper is to be drawn into the bath. They need only be left in the bath for a length of time sufficient for the heat of the bath to thoroughly penetrate the work, although if the temperature of the bath is kept constant the work may be left in for an indefinite time without the least danger of running the temper too low. The work to be tempered may be suspended in the bath by means of a wire basket and all parts of the pieces immersed, whether of thin or thick section, will be evenly heated, thus ensuring an even temper, or degree of hardness, throughout. This method offers the great advantage that drawing temperatures which have been found to give good results may be repeatedly employed on particular work with absolute certainty of uniformity of results.

A ROUGHING TAPER REAMER.

In the manufacture of the Stow flexible shaft and kindred apparatus at the shops of the Stow Manufacturing Co. extensive use is made of the Jones & Lamson flat turret lathe, and many jobs are done on it which in other shops would be done on engine lathes. For instance, all the Morse taper sockets are bored and turned on one of these machines at considerably less expense than if done in the way that would ordinarily be followed. The sockets are made from bar steel, and the taper holes bored and reamed with turret tools. The form of reamer used for roughing the taper hole is shown in Fig. 1. The teeth are "stepped," which allows them to cut much more freely than if of unbroken taper. All the finishing reamer has to do is to smooth off the projections left by the roughing reamer.

The reamers are held in the regular holders furnished with the lathe, bushings being made like that shown at *B*

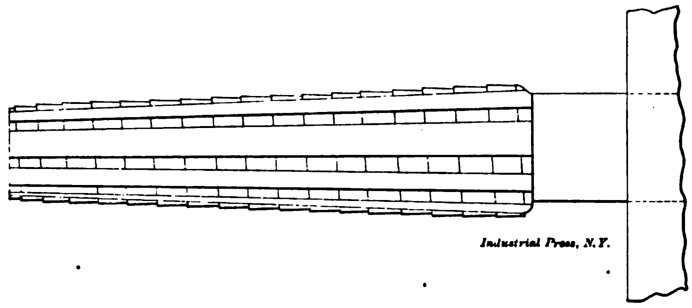


Fig. 1.

in Fig. 2. These bushings are of cast iron turned to fit the holder and bored to a close fit on the reamer shank. They are split through at one side and then a number of cuts are

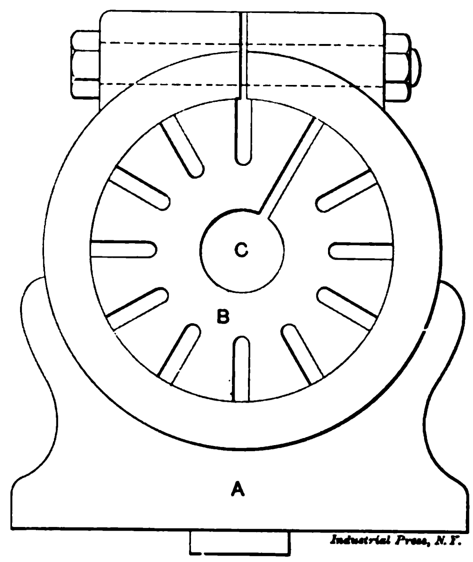


Fig. 2.

made longitudinally, as shown, to make the bushing more flexible. With this construction it is possible to hold round shank reamers with great firmness by tightening the clamping bolt of the holder.

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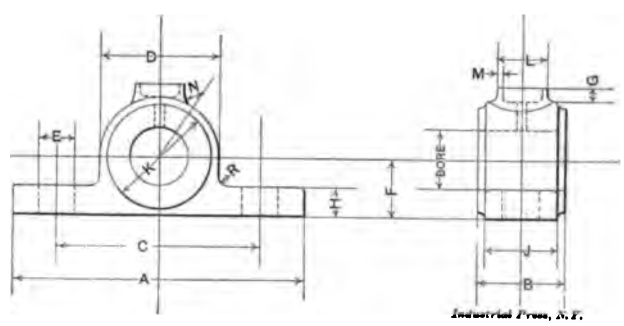
PROPORTIONS FOR PLAIN BEARINGS.

GEO. W. CHILDS.



Plain Bearings.

Diam. of Shaft.	A	B	C	D	E	F	G	H	J	K	L	M	N	R
⅜—½	2¼	¾	1¾	1	5/16	9/16	..	¼	⅝	⅞	..		..	3/32
⅝—¾	3⅜	1⅛	2⅝	1½	5/16	27/32	..	⅜	⅞	1 5/16	..		..	⅛
⅞—1	4½	1½	3½	2	7/16	1⅛	..	½	1⅛	1¾	..	..	..	3/16
1⅛—1¼	5⅝	1⅞	4⅜	2½	9/16	1 13/32	⅜	⅝	1⅜	2¼	1	⅛	7/16	5/16
1⅜—1½	6¾	2¼	5¼	3	⅝	1 11/16	⅜	¾	2	2¾	1¼	⅛	½	⅜
1⅝—1¾	7⅞	2⅝	6⅛	3½	¾	1 31/32	7/16	⅞	2¼	3⅛	1½	3/16	9/16	½
1⅞—2	9	3	7	4	⅞	1¼	7/16	1	2⅝	3½	1¾	3/16	⅝	⅝
2¼—2½	11¼	3¾	8¾	5	1	2 13/16	½	1¼	3⅜	4⅜	2	3/16	11/16	¾
2¾—3	13½	4½	10½	6	1⅛	3⅜	⅝	1½	4⅛	5⅛	2¼	¼	¾	1
3¼—3½	15¾	5¼	12¼	7	1¼	3 15/16	¾	1¾	4¾	6½	2⅜	¼	13/16	1⅛
3¾—4	18	6		8	1⅜	4½	¾	2	5½	7½	2½	5/16	⅞	1⅜

Formulæ:

A = bore × 4½
B = " × 1½
D = " × 2
F = " × 1⅛
H = " × ½

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MACHINERY

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LESTER G. FRENCH, Editor. FRED E. ROGERS, Associate Editor.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

OCTOBER, 1901.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

1900.		1901.		1901.		1901.	
Nov.....	25,000	Feb.....	26,500	May.....	26.500	Aug.....	29,492
Dec.....	27,500	Mar.....	30,000	June....	28.000	Sept.....	28,165
Jan.,'01.	27,500	April....	26,000	July.....	28,964	Oct......	28,345

No other paper in this field prints its circulation figures.

The index for the last volume of MACHINERY is ready for distribution and will be sent to any reader desiring it, upon application by postal card.

* * *

A HINT FOR THE LONG EVENINGS.

There is always an opportunity for machinists, draftsmen and others familiar with machine shop methods to contribute to our columns with profit to themselves and to the betterment of the paper. The question, "What shall I contribute?" is often asked. All that we can say to this, in a general way, is that MACHINERY is a paper for the machine shop, and that it aims to publish matter of practical value for men connected with machine shops, whether they be apprentices, journeymen, draftsmen or superintendents. A person who is in the habit of observing and thinking for himself will at one time or another run across many interesting things in the round of his daily duties, some of which may be unusual or out of the ordinary, and so furnish material for a contribution; or he may know of methods or special tools which have proved valuable, and a description of which would be appreciated by others. Other things being equal, contributions illustrated with sketches, or, better yet, with photographs, are preferred.

If there are any who have a subject in mind which they think might be suitable for an article or a letter for the correspondence department, we ask them either to correspond with us about it or to submit the contribution. We invariably revise all manupscript, rewriting if necessary, and redraw all sketches before publication, if required, no matter by whom prepared. There is no reason, therefore, for anybody to hesitate because he is not accustomed to writing or is not able to make good sketches. In fact, such people are the ones who will be benefited most by contributing, provided they have practical ideas to write about.

The INDUSTRIAL PRESS, publishers of MACHINERY, also publish STEAM ENGINEERING, which is a monthly paper of the same size as MACHINERY, but devoted to the generation and transmission of power. Readers of MACHINERY who are familiar with the construction, erection and repairs of the machinery and appliances used in power plants are also asked to submit articles which they think will be helpful to engineers of such plants, for publication in STEAM ENGINEERING.

REMARKABLE GROWTH OF THE STEEL INDUSTRY.

The steel industries of the country have been brought prominently before the public through the labor troubles of the past few weeks. Another reason, however, why they are attracting widespread attention in all quarters of the globe is the fact of their remarkable development during the last decade, giving them the leading position among the foremost industries of the world. During the last 10 years the increase in the production of coal in the United States has been 60 per cent; of coke and iron ore, 80 per cent, and of pig iron, 70 per cent. There were produced in this country in 1900, in round numbers, 238,900,000 tons of coal, 26,000,000 tons of iron ore, and of pig iron 13,800,000 tons. In 1899 our production of iron ore exceeded that of Great Britain by 3,200,000 tons, although the latter country imported 7,000,000 tons of her product, and exceeded the production of Germany by 6,700,000 tons. Our production of coal in 1900 exceeded that of Great Britain by 13,700,000 tons, and of Germany by 89,300,000 tons. Our production of pig iron in the same year exceeded that of Great Britain by 5,800,000 tons, and that of Germany by 5,400,000 tons.

No contributions to the daily press in recent years have attracted so widespread attention as a series of letters in the *London Times* on "American Iron and Steel Industries." These were published something over a year ago, and were written by British engineers and afterward collected and printed in book form. There was a general agreement among the different writers that the remarkable growth of these American industries was due, among other causes, to the almost inexhaustible supply of high-grade ores and coking coal, the improved methods of operating, especially in respect to mining and conveying the coal, and finally the immense home market.

Twelve years ago as good an observer of industrial conditions as Mr. William Kent, the consulting engineer, made the prediction that even with equal labor conditions the United States could not hope to compete with England and Belgium in the metal markets of the world owing to the disadvantageous locations of our coal and iron fields with respect to the centers of industry. As a matter of fact, we are competing successfully for the "markets of the world," owing to the improved methods adopted in this country referred to in the *London Times'* letters. What these improvements have been were hinted at by Mr. Kent in a lecture given before the students of Sibley College last year, when, in referring to his previous prophesy he said:

"I was a poor prophet, but who could have foreseen eleven years ago that the Mesaba iron ore range would be discovered, and that its ores would be mined with a steam shovel; that railroad cars filled with ore would be lifted bodily and their contents transferred directly into the hold of a vessel; that 6,000-ton ore vessels would be built to carry the ore on the lakes; that a railroad could be built from Lake Erie to Pittsburg with ore cars of 100 tons capacity each; that these cars would be unloaded without manual labor, and that the barrows in the ore bins would be loaded automatically and in like manner dumped into the furnace? Who could foresee that the geographical disadvantage would be removed by improved methods of transportation?"

In the *International Monthly* for August is an article by John Franklin Crowell upon "American Primacy in Iron and Steel Production" in which certain phases of the development of these industries are touched upon. Attention in particular is called to the way in which the manufacturers of the United States have taken advantage of inventions for the utilization of iron ores. The Bessemer process requires a high-grade ore, such as is found at the head of the Great Lakes, while the more expensive open hearth process is adapted to low-grade ores which abound in other countries. The United States has thus become the home of the Bessemer process, while England and Germany have had to resort to the more expensive method, owing to the absence of ores in sufficient quantity, thus giving American manufacturers an undoubted advantage.

The United States, however, is also rich in low-grade ores, too high in phosphorus for the Bessemer process, and the

open-hearth process is making rapid strides, its production having more than doubled since 1897, and the demand is constantly increasing for this class of steel. The footing of the steel industry as a whole, without regard to the kind of process, is shown by the facts that in 1891 only 47 per cent of our pig iron was converted into steel, while in 1899, 77 per cent was so converted.

At the beginning of the decade our imports of iron and steel were valued at nearly twice the sum of our exports in these products, and now our exports are more than five times the value of the imports. We have for years been the leaders of the world as builders of railroads; we have led in bridge building and in the use of structural steel for all purposes; we have used more iron and steel in the construction of machinery than any other country, and of all the uses to which these commodities are put we have held a secondary position in shipbuilding only. But in spite of these conditions our iron and steel industries have outgrown the home market, and in alluding to this Mr. Crowell says the turning of the tide in the American iron and steel trade marks the end of an old and the beginning of a new régime. This industry is so completely organized that it must enlarge its markets to save itself. Will it continue to follow the two-price policy of getting all it can out of the home market and having irregular recourse to the foreign market at a price far enough below the domestic price to carry off its surplus products as they happen to accumulate, or will it cultivate the world market systematically?

* * *

NOTES AND COMMENT.

Worship assisted by machinery in churches appears to have some drawbacks. While the anthem was being sung in an East Orange, N. J., church recently, a fuse on the electric motor driving the pipe organ pump blew out with a bang. After an awkward pause the service was continued without the musical accompaniment. The irreverence (and some other qualities) of modern electrical apparatus is very shocking.

Reports are occasionally published of automobiles catching fire where gasolene is used for fuel. A motor wagon at Springfield, Mass., had this propensity, and the chauffeur, with remarkable presence of mind, ran his machine through the streets to the nearest fire engine station and called upon the firemen to extinguish the flames. The foreman of the company thought it was the first time he had heard of the fire being brought to the firemen instead of the firemen having to go to the fire.

As an auxiliary engine for use in emergencies there stands in the engine room of the West Albany shops of the N. Y. C. R. R. a beam engine built forty years ago. For years it furnished power for the shops and is occasionally used yet when necessary. The flywheel is 20 feet in diameter and is also a gear wheel having inserted wooden teeth. The teeth are 18 inches across the face of the wheel and are of 4-inch pitch. The first set of teeth ran continuously from 1861 to 1895, a period of 34 years. The diameter of the cylinder is 34 inches and the stroke is 72 inches. The valve motion is that so commonly used on lake and river steamboats. The engine is in fact a typical eastern river steamboat engine. It was built by the Franklin Foundry in 1861.

The attempt that has recently been made by the Bodwell Granite Co., Vinalhaven, Me., to turn and polish, in a single piece, in a specially constructed lathe, the immense granite pillars for the Cathedral of St. John the Divine, in New York City, has not been attended with success. The pillars, which are required to be 54 feet long by six feet in diameter and weigh nearly 140 tons, proved to be too long and slender to withstand being handled thus, as the first two attempts resulted in the pillar breaking while in the lathe. It was rather surprising that this should happen as the granite used is remarkable for its great strength and freedom from checks and seams. This immense lathe, which was described in MACHINERY for April, 1901, page 252, was built especially at a cost of $50,000 for the purpose of finishing these columns. The lathe swings six and one-half feet and is sixty feet between centers, weighing complete 135 tons. Its total length is 86 feet, and it has four carriages and eight rotary cutters. The pillars will probably be finished in short lengths and assembled at the church in the usual way.

We recently called attention to the use of electricity for operating rock drills, the reciprocating motion of the drill being obtained from a plunger operated by the magnetism of coils of wire which form solenoids through which the plunger is made to reciprocate. While compressed air has generally been considered the best mode of power transmission for reciprocating tools like rock drills, hammers, punches, etc., this electric drill appears to be simple and effective. There is another type of electric drill in use, however, in which power is transmitted to it from a small motor by means of a flexible shaft and this rotary motion is transformed into reciprocating motion at the drill by a crank movement. The crank pin runs in a cam slot in a draw bar or cam plate, and the shaft of the slot is such as to give a quick forward motion, which imparts a sharp blow and a slower return. The draw bar is connected to the plunger through spiral springs of sufficient strength to convey the force necessary for the blow of the drill. There is a balance wheel geared directly to the crank shaft and the rotation of the drill is effected by a ratchet movement.

The excavations necessary for the new subway which is now building in New York often disclose water mains and valves whose existence has been forgotten. In some cases the mains are in use, but the controlling valves are useless, since their location has been lost or the boxes for the valve stems covered over. In Mail St., opposite the Post Office, two large gate valves were noticed which must have been useless since the openings to the valve stems had been covered with asphalt. The crying need in great cities is a better method of carrying pipes beneath the surface of the streets. The old process of digging up the pavement whenever a new line is to be laid, or when repairs are necessary, means a huge waste of labor and the inconvenience of the public using the streets. With subways or pipe galleries along the principal streets, the convenience of the public would be greatly increased and the cost of laying and maintaining pipe lines proportionally reduced. With such a system, the locations of valves and junctions would not become lost as in the present uneconomical system, and the deterioration from rust and corrosion would undoubtedly be considerably lessened.

ELECTRIC TRACTION ON THE MANHATTAN ELEVATED.

Evidences of the approaching conversion from steam to electrical motive power of the lines of the Manhattan Elevated Railway Co., New York City, are to be seen in the progress on their main power house and east-side sub-stations, and in the projected sub-stations for the west-side lines.

The company has recently filed, with the Department of Buildings, plans for the sub-station power houses for its Sixth and Ninth Avenue elevated lines. There will be three sub-stations and one repair shop, and the combined cost of these will be $133,000. The sub-stations are to be used to transform the high-tension three-phase electric current generated at the company's main power house, at Seventy-fourth Street and the East River, down to the line voltage and into direct current for use in their third-rail system.

These new buildings will be situated as follows: A four-story brick sub-station at 173 to 175 Spring Street, a four-story brick sub-station at 354 to 356 West Fifty-third Street, a two and three story brick sub-station on the north side of One Hundred and Tenth Street, near Manhattan Avenue, where the Ninth and Sixth Avenue lines make the curve from Columbus into Eighth Avenue, opposite Morningside Park; and a two-story brick repair shop at One Hundred and Eightieth Street and Lafontaine Avenue.

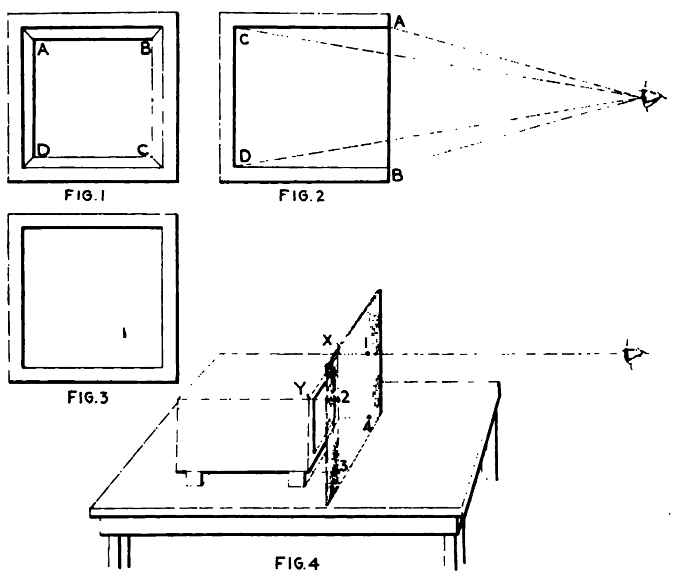
The east side sub-stations are fast nearing completion. The walls are up for the stations at Allen and Division Streets, at East Thirty-fourth Street, near Second Avenue, and at Ninety-ninth Street and Third Avenue. At the One Hundred and Sixty-first Street and Third Avenue sub-station the steel frame is now going up.

WORKING DRAWINGS.—1.

HINTS UPON READING AND MAKING WORKING DRAWINGS—THE CONVENTIONALITIES USED.

A working drawing should convey to the eye of the observer a clear idea of what the draftsman or designer wants made, and of how the various details are to be carried out. The drawing should be so complete that when it is passed into the shop no further questions will be necessary, and to this end all necessary information as to material, bolts and screws, the kind of fits and finish desired, etc., should be plainly marked on the drawing.

It is not the business of the mechanical draftsman, however, to make pictures, and he seldom has occasion to draw perspective views. He has to convey his ideas by simpler methods than this and in making working drawings uses what is called "Orthographic Projection," or projection, simply. His drawing may not always look like the object, from the pictorial standpoint, since certain conventional figures and methods are adopted to represent machine parts, which can be drawn much quicker in this way than if their true form were



Views in Perspective and in Orthographic Projection.

reproduced. Thus, it is not customary to draw screw threads in the way in which they actually appear to the eye; an easier and quicker method of representing them is adopted and the same is true of other parts.

To read working drawings, or to be able to make them, one must not only be familiar with the conventional methods commonly used, but he must understand wherein they differ in principle from perspective drawings or photographs, which represent the object as it appears to the eye.

To a novice a working drawing looks like a lot of lines that do not represent clearly what they are intended to show; but an experienced mechanic or draftsman finds that his attention is not taken by the mere lines and that he involuntarily thinks of the objects which they stand for.

Projection Drawing.

Briefly stated, when a drawing is made by projection, it represents an object as one would see it if his eye could be directly over each point of the object at the same time; or, what would be the same thing, if he could stand at an infinite distance from the object and still observe it.

By a very simple illustration the reader will be able to understand the meaning of this definition and will see what is the difference between a view in perspective, such as one sees in a picture, and a view in projection such as one finds in a working drawing.

Stand an open box on its side and then look at the box with your eyes directly in front of the open side; or if preferred, place a camera in this position and photograph the box. The result will be a view like Fig. 1, where not only the front edge of the box appears, but the interior sides and bottom as well, as indicated by the lines *A*, *B*, *C*, *D*. The reason for this is that the lines of sight diverging from the eye of the observer reach both the front edge of the box, as indicated at *A* and *B* in Fig. 2, and the bottom, indicated at *C* and *D*. This is a view in perspective and from it one gets a partial idea, at least, of the shape and depth of the box, besides the shape of the front edge.

In Fig. 3 is the same view of the box, but shown in projection. Here there is nothing to indicate what the depth of the box is. The view gives a conception of the shape of the front, but to form an idea of its depth there must be another view taken at right angles to the front view.

In Fig. 4 is shown how this view in projection may be supposed to be produced. The box is placed on the table and in front of it, and parallel with it, is a piece of glass. Let a person stand so that his eye will come directly in line with one corner *X* of the box, as in the illustration, and make a dot on the glass, indicated by point 1, where the line of vision passes through the glass to this corner. Now let him move until his eye comes exactly in front of point *Y*, and mark point 2 on the glass, and so on, all the way around. Then, by connecting points 1, 2, 3 and 4 he will have a correct representation in projection of one edge of the front of the box.

The lesson taught by this is that a projection drawing gives no idea of distance to or from the observer in a single view, but represents, simply, the distance in any direction in a plane surface like a sheet of drawing paper, held squarely in front of the observer. This is why more than one view is required to show in projection what may be evident in a single view in perspective. Also, in projection, the views, generally being taken at right angles, represent the sizes of machine parts accurately, while in perspective part or all of them may be foreshortened, making it difficult to properly dimension them.

Arrangement of Views.

In Fig. 5 are four views of a wedge-shaped block in the top of which is driven a round pin. All these views of so simple an object are, of course, unnecessary, and they are merely shown to indicate the correct positions of the different lines in the several views. The front view appears as though the object were held directly in front of the observer. The top view is placed above the front and appears as though the observer were looking down upon the object. The end view at the right shows the block as it would appear if looked at from the right-hand end, and the end view at the left shows it as it would appear if looked at from the left.

The views, arranged as here shown, are in what is known as the "third angle of projection," the full meaning of which

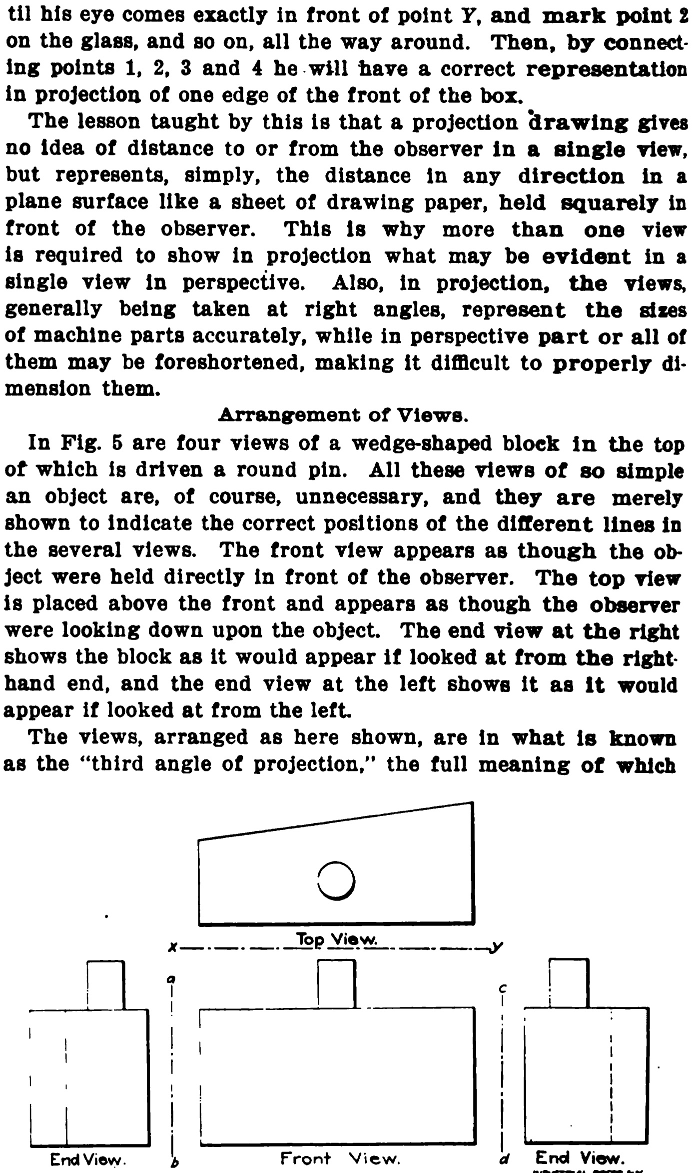


Fig. 5. Arrangement of Views.

cannot be explained without taking up the elementary principles of projection, a treatment of which is to be found in any book on mechanical drawing. This is the arrangement commonly adopted for machine drawings.

In Fig. 6 is an arrangement of views of the same object in what is known as the "first angle of projection." This arrangement is generally employed in architectural and in structural work, such as in drawings of bridges, etc., but is not so often used for machine drawings. It will be noted that in Fig. 6 the top view is below the front view, the view of the right-hand end of the block is shown at the left and the view of the left-hand end is shown at the right. Comparing further, it will be seen that in Fig. 5 the pin in the front view points toward the top view, while in Fig. 6 it points away from it; and in the end views the pin appears near the inside edges in Fig. 5 and near the outside edges in Fig. 6. The views are so

arranged in Fig. 5 that if the top view be placed directly on top of the block and then the sheet of paper be folded over on the line x y, the front view will come directly in front of the block; and then if the sheet be again folded or bent back along a b the left-hand end view will come in front of the left end of the block; and, finally, if it be folded back along c d the right-hand end view will come in front of the right-hand end of the block. If the block were inclosed in a box having transparent sides and the outlines of the block were traced on each of the sides as they appeared to an observer looking through the successive sides of the box, and finally the sides were unfolded so as to lie flat in one plain, the views would appear as in Fig. 5.

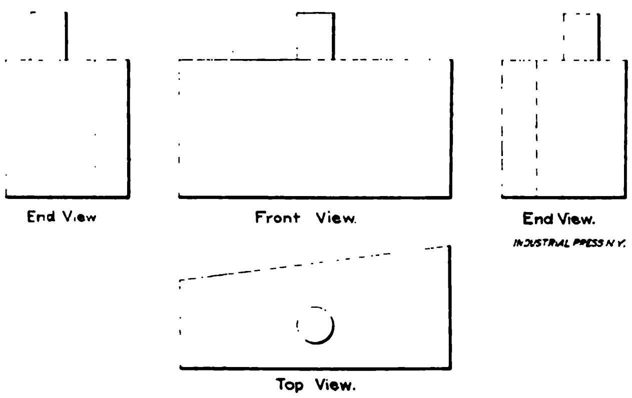


Fig. 6. Another Arrangement of Views.

To produce the arrangement shown in Fig. 6 we may assume the block to rest on the paper with its top side uppermost. If we then mark around the block with a pencil we will get the top view shown. If the block then be tipped over with its front side uppermost and we mark around it, the front view will be obtained. Again, if it be tipped first on one end and then on the other the two end views will be obtained.

A close study of Figs. 5 and 6 will show how necessary it is to adopt some one system and to adhere to it, as otherwise there will very likely be much confusion in the shop and perhaps mistakes made by the patternmaker.

Conventional Lines.

The various styles of lines used in working drawings are shown in Fig. 7. The ordinary line (1) is for outlining objects, for section lining and for all ordinary purposes. The shade line (2) is used to represent the edges supposed to separate the light from the dark surfaces of an object—that is, the surfaces on which the light strikes from those in shadow, as shortly to be explained. The dotted line (3) is chiefly for representing the details of an object when they are so covered as to be obscured from view. Many details can be represented in this way and their arrangement clearly indicated, although they would not be visible in the actual piece. The dash line (4) is used mainly for dimension lines. The dash and dot line

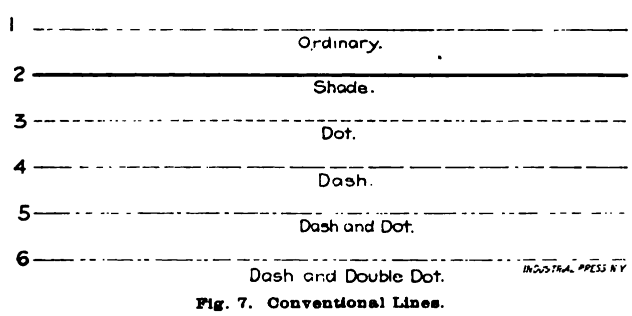


Fig. 7. Conventional Lines.

(5) and the dash and double dot line (6) are both used for center lines, some draftsmen preferring one and some the other. When a drawing of a piece, like a wheel or a bolt, for example, is symmetrical, a center line is sometimes drawn through the center or axis of symmetry of the figure, and if there are two views of the same piece the line is frequently extended through both, showing that they are connected. The dash and dot line (5) is also used for connecting lines between different views, as in Fig. 8, and for construction lines in laying out mechanical movements or geometrical figures. In no case are the lines (5) and (6) used to represent the actual edges or surfaces of a piece, except occasionally when they are made to indicate the plane in which a piece is supposed to be cut or broken, in order that a sectional view may be shown in that plane. Examples of this will be shown later.

Shade Lines.

In architectural drawing the effect is improved by taking account of the shadows that would be cast by the sun were it shining upon the object. The rays of the sun are supposed to come from above and from the left at such angle that when projected on the paper they would be represented by lines, making an angle of 45 degrees with the horizontal and vertical. A great deal of time is sometimes spent in determining which surfaces should be light, which in shadow, and what the shape would be of the shadows cast.

In mechanical drawing attention is sometimes paid to this point to a limited extent. Assuming the sheet to be held directly in front of the observer, and the light to come from over his shoulder in the direction of the diagonal of a cube, heavy lines would be drawn along the edges separating the light from the dark surfaces. In many cases it requires considerable study to determine what lines should be shaded when adhering strictly to this method. In the majority of cases, however, it is the lower and right-hand lines that must be shaded, and the best practice is to follow this general rule without regard to the exact manner in which the light strikes. When the lines are used in this way they answer the purpose of improving the appearance of the drawing, and they also indicate which are the raised and which the depressed surfaces. This will be clear from Fig. 8, in which

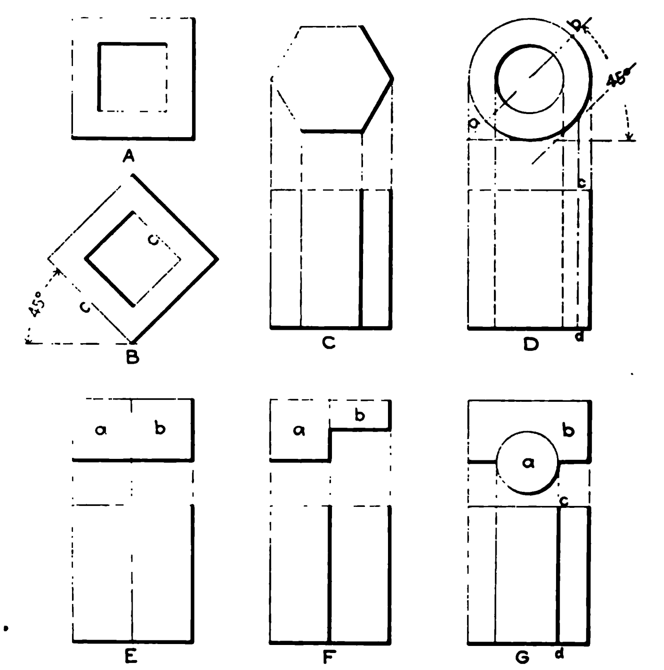


Fig. 8. Shade Lines.

several examples of shading are shown. At A is a square block, hollow in the center. The outer shade lines show that the block is raised above the surface of the paper, and the location of the inner lines shows that the center of the block is depressed below the outer surface of the latter. At B is shown how the block would be shaded if at an angle of 45 degrees. Since the projection of a ray of light is supposed to be at 45 degrees there is no logical reason why the lines C C should not be shaded instead of those shown; but the figure looks well as drawn. At C is the shading for a hexagonal prism, and at D for a hollow cylinder. The shading on the top view of D starts at the 45-degree line a b, gradually increases and then diminishes to nothing when it again reaches the line. The right-hand element of the cylinder in the lower view of D should not rightly be shaded because it really separates two dark surfaces, the shadow actually starting on the element c d. In practice, however, the right-hand element is the one shaded. At E are two blocks a and b of the same size. No shade line would be used to separate them; but at F, where blocks at a and b are of different thicknesses, the shade line would be necessary. At G the block b is recessed for the cylinder a. It may be shaded as shown.

although some draftsmen might prefer to leave off the shade line *c d* in the lower view.

Screw Threads.

Conventional methods of representing screw threads are shown in Fig. 9. These are the most common methods, although there are some others less frequently met with. Methods *A* and *B* are generally employed, and of the two that at *B* is to be preferred, as it is more easily done. Some draftsmen place the heavy lines shown at *B*, representing the bottoms of

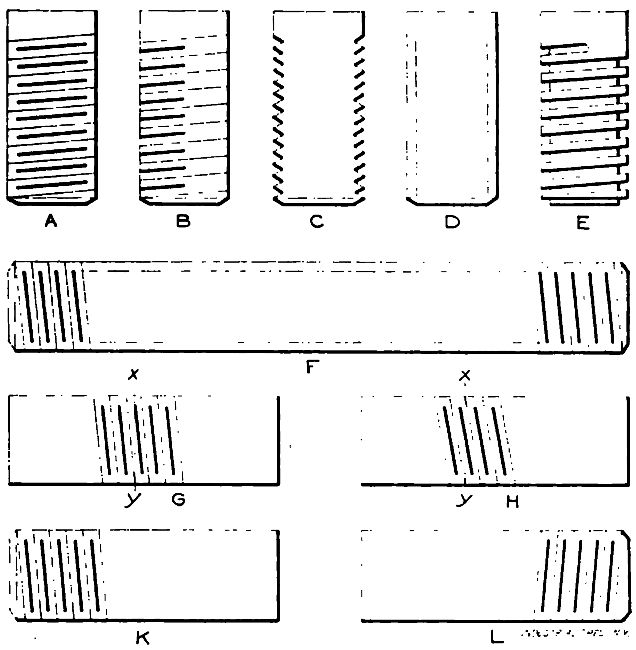


Fig. 9. Conventional Threads.

the threads, on the right-hand side instead of on the left-hand side, as it then gives the effect of shading. At *E* is a conventional square thread. If any long piece is to be threaded the entire length, the threading can be indicated as at *F*, which saves drawing the complete thread. The difference between the representation of a single and a double thread is indicated at *G* and *H*. The single thread is at *G* and the inclination of the lines is such that the line *x y*, at right angles to the axis of the piece, passes through the top of the thread at one side and the bottom of the thread on the other side of

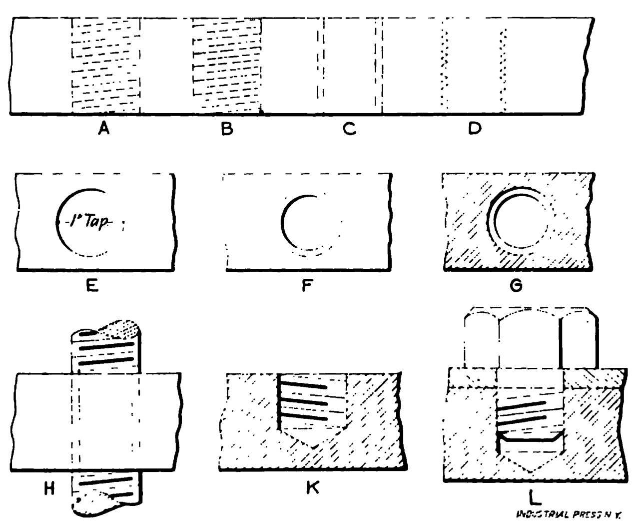


Fig. 10. Representation of Tapped Holes.

the bolt. At *H* the inclination is such that the line *x y* passes through the tops of the threads on both sides of the bolt. At *K* is shown a right-hand thread and at *L* a left-hand thread.

Tapped Holes.

At *A B C D*, Fig. 10, are methods of representing tapped holes where they are obscured from view and must be shown by dotted lines. Those at *A* and *B* are much used, but where the drawing is crowded those at *C* and *D* are to be preferred, and in any case they make a neater appearance. Top views of surfaces having tapped holes may be indicated either as at *E* or *F*. If as at *E*, a circle should be drawn of a diameter equal to the outside diameter of the bolt, and the hole marked as indicated, which shows that the hole is to be tapped and also indicates the size of bolt to be used. If the method at *F* is employed the inner circle should be approximately equal in diameter to the diameter of the bolt at the base of the threads, and the outer dotted circle should be equal in diameter to the outside diameter of the bolt. At *G* is the top view of a tapped hole as it appears in a sectional view. At *H* is a representation of a threaded piece which extends through a block threaded to receive it, as shown. At *K* is a vertical section through a tapped hole. This is for a right-hand thread, although the lines incline as though it were a left-hand thread. This is simply because only that part of the thread is visible which is at the furthest side of the hole where the threads must, of course, incline in a direction opposite to the direction they take at the front side of the hole. This can be

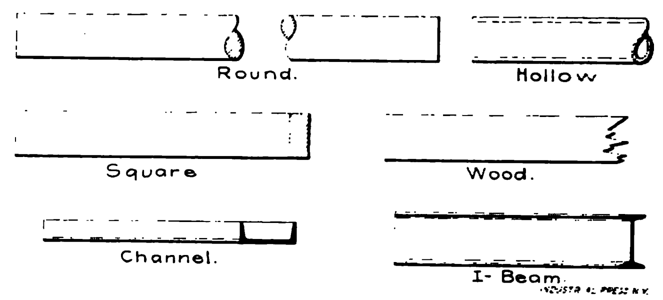


Fig. 11. Broken Sections.

clearly seen by examining a bolt or nut. At *L* is shown a section through a tapped hole into which a bolt has been screwed.

Broken Sections.

In Fig. 11 are shown methods of representing bars and rods, shafting, structural beams, etc., when it is not convenient to show their whole length on the drawing. In such cases these pieces would be drawn as long as the limits of the drawing would allow and then would be broken as indicated, to show that the full length of the piece is not represented. In placing the dimensions on the drawing the full length would, of course, be given.

In the next article some other conventional methods of working drawings will be dealt with.

* * *

The Waterbury Farrel Foundry and Machine Co., Waterbury, Conn., have under construction an extensive addition to their machine shop. A new four-story office building is just being completed, and their old office, which adjoins their present shop, is being torn down, as well as part of the old shop, to make room for a large heavy machine and erecting shop. The new shop will be 200 feet long by 45 feet wide and will be traversed by a large capacity traveling crane.

Unusually heavy concrete foundations are being laid for the purpose of making ample allowance for supporting the crane, with sufficient reserve capacity to allow for extensions. This new shop will greatly assist the company in its rapidly increasing business and relieve the congested condition in their present heavy machine shop.

* * *

In the discussion following the reading of a paper which called attention to the various factors of train resistance at the New York Railroad Club at the May meeting, it was pointed out that the resistance of a train rounding a curve is not similar to that of a rope around a snubbing post, as is quite popularly believed. Instead, the resistance due to rounding curves is almost entirely due to the flange friction against the outer rails because the tendency of the wheels is to proceed in a straight line irrespective of the direction of the pull of the locomotive. It was also pointed out that on curves of the same radius, the conditions are identical even if the curve was 360 degrees long. That is, the tendency of the locomotive to draw the wheel flanges against the inner rails would be no greater than on one of less number of degrees of angularity. The total resistance, however, would be proportional to the number of wheels on the curve so the greater the curvature in degrees the greater the resistance due to frictional effect on the outer rails.

LETTERS UPON PRACTICAL SUBJECTS.

THE PUSHES, PULLS AND TWISTS THAT THINGS GET IN A MACHINE SHOP.

Editor MACHINERY:

Nothing is more important in the operation of machine tools, or, in fact, machinery of any kind, than to see that no part is ever loaded beyond its elastic limit. As this point can but rarely be determined accurately, it is best to keep on the safe side by always allowing a liberal factor of safety. It must not be understood that tools are necessarily to be "nursed," but that they are simply to be given the long end of the lever, when it can be done as easily as not, as it frequently happens.

Take, for example, a piece of flat iron or steel with one or more bolt holes through it, which is called a clamp, or, less frequently, a button. A clamp is in close partnership with a bolt when in use, and always on the "bear," or squeeze side, in every deal. Occasionally, when the work comes loose, the "bulls" get the best of it and the nuts and clamps are temporarily elevated. Fig. 1 shows a pedestal clamped to the planer table, ready to be cut out at the top for the cap. It will be noted that the nut has been screwed down till the clamp *M* is bent, receiving an injury from which it will never fully recover. Right here let us stop and study briefly this important peculiarity of iron when subjected to stresses, and will not, however, stand near the punishment in this respect that wrought iron or soft steel will. The nut, therefore, should not be tightened to a point where the parts will not recover their original form upon releasing the pressure of the nut. I have often thought that apprentices could be taught to think and be careful if these things were made for them of cast iron.

When the pedestal is planed and the clamp, *m*, is removed, the probabilities are that the next time it is used it will be the other side up, giving it a reverse curve, and after a few repetitions of such treatment it will be found to bend easier and finally cracks will appear, as at *k*, which are the marks, though not always to be seen, that sooner or later reduce the value of all machine parts that have been subjected to alternate strains to that of scrap iron. The clamp has been referred to as an object lesson only, for it is cheap and easily replaced. If, however, it is a lathe bed, carriage or spindle that gets its initial bend it is a serious matter. Before dropping the clamp out of consideration, however, I beg to call attention to the one on the right hand side of the pedestal, Fig. 1, as being made and used in a popular and up-to-date manner.

Bolts and studs are liable to break at any time after they have been screwed up just a little too tight, and especially so

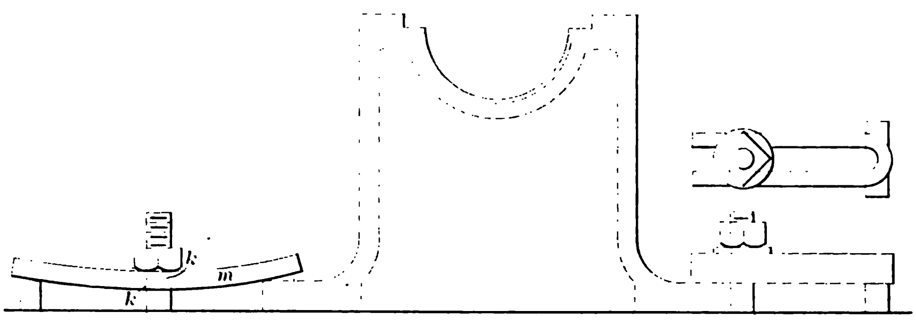


Fig.1

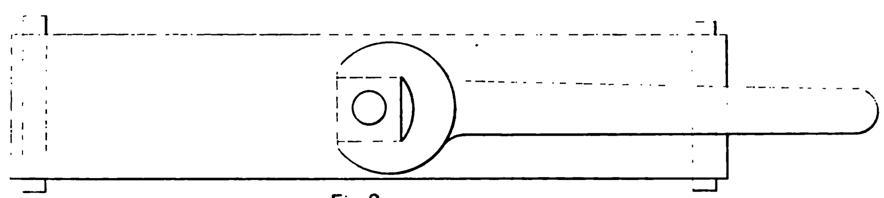


Fig.2

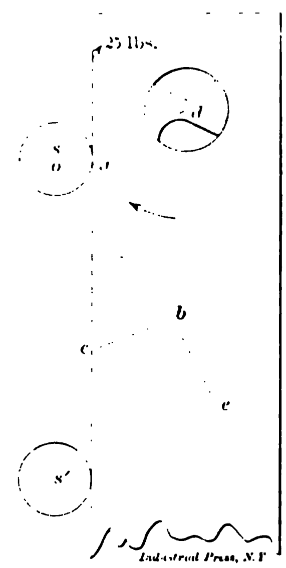


Fig.3

Figures Illustrating Stresses that occur in Machine Work.

verify what has just been said in regard to the injury caused by bending it. If the bolt, clamp and all parts connected with them were perfectly rigid and unyielding, then, when the nut is run down on the thread till it touches the clamp, it will be impossible to turn it further down without breaking some part. It is well known that such is not case, so it is evident that some or all the parts are changing their shape, as the nut is screwed down. The important question then arises: When is the nut as tight as it is safe to turn it without permanently springing the clamp or straining and injuring the bolt and nut?

To make this point clear, let us take a new,straight clamp, support it at both ends, and put a bolt in the middle, as shown in Fig. 2; then run the nut down till it just touches the clamp hard enough to be felt at the end of the wrench, and mark the position, as at *p*. Now turn the nut down, say one-fourth revolution, then back about a half-turn, or far enough to take up the lost motion between wrench and nut, and then turn it the other way to the starting point *p*. Repeat this, turning the nut further each time, and it will be found that the nut does not tighten on the clamp in the same position that it did at the start, which proves that some part has been strained beyond its power to recover. Had the clamp, bolt and nut been made of close cast iron, and subjected to the treatment just described, there can be but little doubt that a break would have occurred somewhere, even though some grades of cast iron will bend quite perceptibly before breaking, but after they have been tightened in that way several times; and the fact that, as it happens in most cases, the area of the metal at the fracture is not reduced, is strong evidence that they have been subjected to crippling strains, since if a new bolt is pulled in two it will be found to be reduced at the fracture to, say, three-fourths the original area at that locality. The frequency of wrecks, and an occasional disaster, due to the breaking of bolts or studs that have been subjected to tensile strain only, makes the subject an important one; and it has seemed to me that there ought to be some way of telling when the check nut on a threaded piston rod is screwed up as tight as it should be against the crosshead, as well as the nuts on the steam chest and cylinder covers, or, in short, any nut that requires careful tightening.

Experiments in this line give widely varying results, but approximate averages indicate that two-thirds of the force applied to the wrench is lost in friction, the other third producing effective pressure against the face of the nut. If the tension on the bolt were to be determined in this manner, a wrench with a scale attachment would be required, which might be objectionable. An easier way would be to bring the nut up to its opposing surface with a light pull, and then tighten it by a part of a turn, the amount of which having been determined by experiment on the same size and length of bolt to produce the desired tension. If it has been found that one-third of a turn thus applied on cylinder head bolts gives sufficient pressure to make a joint, it is a waste of time.

and also an unnecessary risk, to keep on going around and pulling each one up a little tighter. If a tension of more than eight thousand pounds per square inch on the studs is required to make a tight joint, there is something wrong with the surfaces, or with the design. The same is true with tailstock bolts, or, in short, bolts and studs anywhere.

Fig. 3 shows an old and easy way to break twist drills, and, if they are ground with lots of clearance so that they will catch when they break through the piece being drilled, there does not seem to be room for improvement; and yet, the advantages of the method are not so fully understood as they should be. Evidently the driller thinks, as the drill does not cut any easier when the work is secure, that to simply hold it from turning is sufficient; and that is true enough if it can be done without throwing an injurious side strain on the drill, which depends entirely on the relationship of the stop to the drill.

In Fig. 3 consider the stop, *s'*, removed, so the work will be kept from revolving by the stop, *s*. It is assumed that the twisting force of the drill will be 25 pounds at the surface of the stop, as shown by the arc drawn from the center of the drill through the point of contact. It will be noticed that the work does not come squarely against the stop so as to directly prevent turning, but strikes obliquely, which wedges the work against the drill, and this introduces a side thrust against the drill, it being assumed that the drill and stop are unyielding and that the friction between the stop and piece is neglected. To measure this side force against the drill the wedging force at *a* may be considered as causing a separation of the rigidly connected points, *d* and *o*, by driving the wedge, *c b a*, toward *a*. Then, represent the line of action of the wedging force of 25 pounds by *a e*. The separation of *d* and *o* would take place along the line *d o*, and if the wedge moved a distance equal to *a b* the points *d* and *o* would be separated a distance equal to *c b*. Since the forces of action and reaction are equal, the products of the forces acting by their movements must be equal, so that 25 pounds multiplied by the distance, *a b*, is equal to the force resisting separation, or the thrust, multiplied by the distance, *c b*. Thus the thrust is equal to 25 pounds $\times\, a b \div c b$, which, since $a b \div c b$ is approximately equal to 2, is 50 pounds.

To make the action of the stop against the drill clear, suppose a distance piece to be put in between the stop and the drill, and then the wedge to be introduced between the stop and the distance piece. Then, if an arm be secured to the drill and the outer end of the arm be attached to the point of the wedge and caused to pull it with a force of 25 pounds, a side thrust of 50 pounds will be transmitted against the drill, tending to bend it. The drill may possibly escape breaking, but, if it does, it will "run" toward the stop and make an ugly looking hole, showing that the drill has milled its way sideways toward the stop and angled off on the opposite side as it went through the piece.

If the stop, *s*, is removed and *s'* put in its place, the side thrust against the drill will be about 5 or 6 pounds, all other conditions remaining the same, which is only about one-tenth of what it is when *s* only is in place.

What is true of keeping work from turning on the drill press holds good also in driving work in the lathe. As a rule, the driver should be kept as far from the center, radially, as convenient in order to relieve the live center from excessive strain, when taking a heavy cut on a shaft near the face plate. If two drivers can be used on opposite sides of the face plate, the strains on the center will be materially relieved. On the other hand, it is, of course, folly to take extra precautions where the work doesn't require it.

Youngstown, Ohio. J. H. DUNBAR.

* * *

SEGMENT WORK IN THE PATTERN SHOP.

Editor MACHINERY:

On patterns of large diameter it is often desirable to use more than six segments to a circle, as the waste is less, and also the grain of the lumber will run straighter with the pieces. However, on smaller work five segments are often better than six. An easy way to obtain the peripheral lengths of these odd segments is as follows: First lay off the circle into six segments. For a five-segment division, divide the peripheral length of one of the six segments into five parts and add one part on to each of five of the six segments. This will give five segments of 72 degrees each. For a seven-segment division, divide one of the original one-sixth peripheral lengths into seven parts and deduct one part from each of the original six lengths, and seven segments of 51 3-7 degrees will be obtained. For an eight-segment division, divide one of the original one-sixth peripheral lengths into four parts and deduct one part from each of the original six lengths as before, and eight segments of 45 degrees will be obtained. Likewise for a nine-segment division, a division of an original peripheral length into three parts and subsequent deduction as before will give nine segments of 40 degrees each.

I once had a thin, flat ring to make. Intsead of breaking the joints on a flat surface, as is usual, I glued one course on top of another, forming concentric rings, each course being larger in diameter than the preceding one. To do this I turned the inside of the first one and the outside of the next one to fit it, and then cut off the first one and glued it outside of the next one, breaking the joints over one another, thus making a circular joint. Then I proceeded with the next one in the same way, and so on until all had been glued together. By offsetting each ring of segments—or, rather, by not putting it entirely over the next one—a beveled ring may be made, such as a bevel-gear rim. This method avoids the thin edges that would occur with a beveled rim made in the usual way. In the case of the bevel-gear rim, the teeth would cross joints in the segments, thus aiding in tying them together. I generally finish segment work with a thin segment on top, and the joints are then not so likely to open.

In building patterns for gear blanks, pulleys, flywheels and similar work, I first put arms together with radial joints, using tongues in saw cuts for joints, glue them together, and then saw them out to shape. Then I put a faceplate on the arms, build segments between the arms of the same thickness as the arms, and then build segments on each side to proper height. In this way, both sides of the rim can be turned without the necessity of rechucking, there being but few cases where the rest cannot be set to the back side of the wheel. This leaves the segments between the arms to be finished by hand. By turning a hole in the center of the arms entirely through, and a corresponding pin for a hub, they will necessarily go together centrally. Thin rings are better when made one segment thick, as they do not warp nearly as readily. I secure the joints by making saw cuts in the ends and inserting hardwood tongues. The thicker the segment, the more tongues are used; if well clamped and thoroughly dried, this makes a very substantial job.

Denver, Colo. J. L. GARD.

* * *

METHOD FOR FINISHING DUPLICATE WORK IN THE SCREW MACHINE.

Editor MACHINERY:

The special tools and fixtures here described were designed for the screw machine, and consist of an improved driver for the work, a special arrangement of lathe centers and a forming tool and holder which will duplicate work without chattering and without regard to pressure applied by the operator.

The particular piece of work for which these tools were designed is shown in two views in Fig. 1, and is called a "goose-neck." It is a brass casting, and is finished at the taper end marked *A*. Before finishing this surface, the castings were centered at *C*, and chamfered slightly on the inside at *B*. The first fixture made for the finishing operation was the special chuck, a cross-section of which is shown in Fig. 2. The body of the chuck was a casting of the shape shown, and was cored out at *C C*. It was first chucked in the lathe and bored out and threaded at *G G* to fit the spindle of the screw machine, and the end squared up. It was then faced and the rim trued. A hole was bored and threaded at *D* to admit the center *E*, which was finished with a shoulder at *F* so as to allow it to rest squarely against the face of the chuck. A square hole was then let through the face of the chuck to admit the driver *I*, which was made of ⅝-inch round tool steel and bent as shown, and the end *I* finished

to a smooth fit within the hole *J*. The round portion *H* of this driver was long enough to allow it to extend clear through the screw-machine spindle, and was connected to the wire-feed lever. This manner of connecting the driver allowed it to be forced out and in, thereby permitting the work to be located on the centers, and removed when finished without stopping the machine.

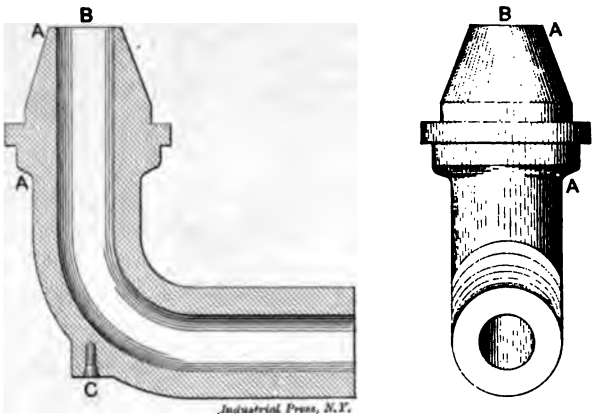


Fig. 1. Sketch of "Goose-neck" to be Manufactured.

As the end *B*, of the work Fig. 1, gives a very narrow bearing for the tail center, and as the work revolved very fast, it was not practical to adopt the ordinary center, as there was a tendency for the end of the work to run hot and burr up. So to overcome this, the special sleeve and running center, shown in a cross-sectional view in Fig. 4, was made. This fixture consists of a sleeve which was first bored out and tapped at the back end for the center end thrust screw *M*. It was then placed on an arbor and turned taper on the outside to fit the tailstock, which had been fitted to the screw machine. The end thrust screw *M* was then made with the thrust end finished flat, hardened and polished. It was then screwed tightly into the sleeve. The running center *K* was then made of tool steel, and finished to fit the sleeve smoothly, and tapered at *L*, and the point rounded. This end was then hardened and polished. After an oil hole had been let into the sleeve and the inside polished smooth, the fixture was finished.

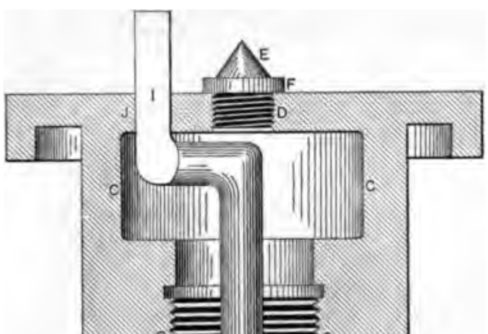


Fig. 2. Special Chuck and Driver.

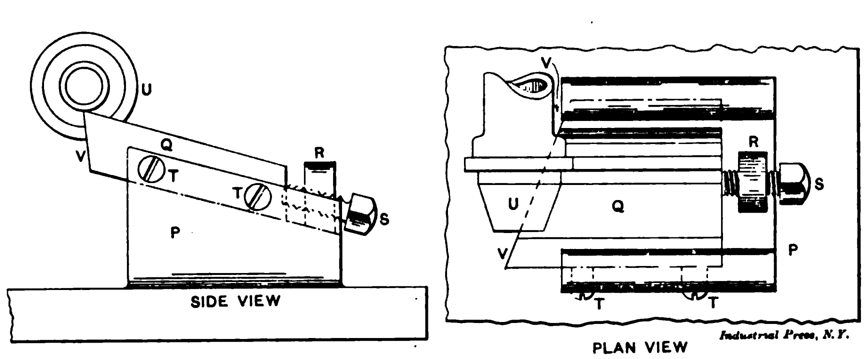


Fig. 3. Improved Design of Forming Tool.

As the manner of finishing the formed surface of the work is distinctly different from the usual methods in general use, and as the forming tool and holder are of a novel design, they are worthy of a detailed description.

By reverting to Fig. 3, in which a plan and side view respectively of the tool and holder are shown, the following description of them will be intelligently understood. The holder is a casting of the shape shown at *P*, and was dovetailed on the bottom and fitted to the cross slide of the screw machine, and equipped with a rack to mesh with the feed gear, as shown at *N*, Fig. 4. The portion for holding the forming tool *Q*, Fig. 3, was then planed dovetail, slanting upward to the degree shown in the side view of Fig. 3. A hole was then drilled and tapped through the lug *R* to admit the tool-adjusting screw *S*. Two headless setscrews, *T T*, were also let into the side, as shown. The forming tool *Q* was of ¾-inch flat tool steel, finished all over and fitted to the holder as shown. The shape required was then worked out on the face for its entire length, and finished in the milling machine with a special fly cutter, as shown in Fig. 4. The cutting face of the tool *V V*, Fig. 3, was sheared off to the angle shown, so as to allow the work to be cut gradually. The tool was then hardened and drawn to a light straw temper, and the cutting face ground and oil-stoned to a keen edge. The fixtures and tools were now complete and ready for work.

The parts were set up on the screw machine in the relative positions shown in Fig. 4. The machine was started, and the driver lever pulled back, thereby drawing the driver *I* into the chuck. The work was then placed on the centers,

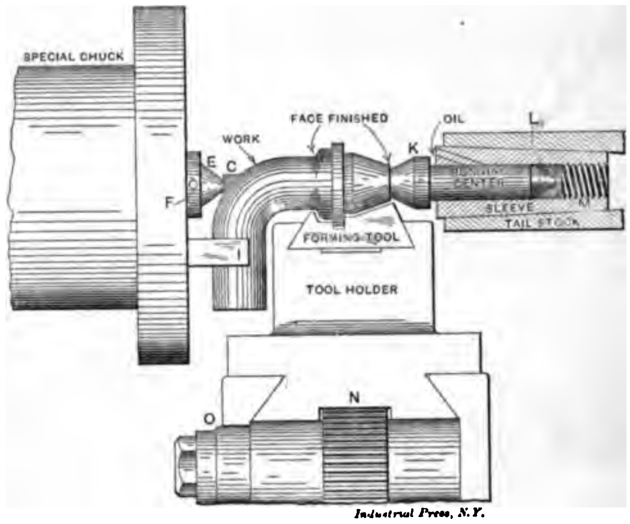


Fig. 4. Special Center for Supporting the Work.

with the portion *C* on the chuck center and the face end on the running center *K*. The driver lever was then pulled out, causing the driver *I* to emerge and drive the work, the running center *L* traveling with it. The handle *O* of the cross slide was then pulled down and the forming tool presented to the work, cutting the face gradually. And as each portion of the work was reduced and finished, that point of the tool passed the center and came out under the work; and as the whole face was finished the entire cutting face of the tool passed free and clear of the work. The driver *I* was then drawn in (without stopping the machine) and the tail center drawn back and the work removed. Another casting was then located on the centers, the driver sent out, and the work finished as before.

As will at once be seen, the use of the special chuck reduces the time necessary to locate the work on the centers, and remove it when finished, to the minimum. And the running tail center eliminates the possibility of the work running hot and burring, as well as the usual waste of time in adjusting the center against the work. The method of finishing formed surfaces by means of tools of the design shown is meeting with more favor all the time, as very wide and intricate forms can be duplicated on round work without any trouble. Another thing, by the use of this tool, work can be finished, one piece in exact duplication of the other

by comparatively unskilled help, with the certainty that each and every part finished will be perfectly interchangeable, as the sizing does not depend on the pressure of the operator's hand on the cross-slide lever, as is the case when the ordinary toolpost-forming tool is used.

By the use of the tools and fixtures here shown, a large number of different shaped castings were finished, all that is necessary for a change being to fit a different forming tool to the holder. The output from the machine to which the fixtures were affixed was increased three-fold, and the expense reduced accordingly.

Brooklyn, N. Y. JOSEPH VINCENT WOODWORTH.

* * *

FIXTURE FOR LAYING OUT KEYWAYS ON TRIPLEX POWER PUMP CRANK SHAFTS.

Editor MACHINERY:

Figs. 1 and 2 represent a very handy fixture for laying out keyways on opposite ends of triplex crank shafts at a definite angle from each other. The crank shaft illustrated consists of a solid-forged middle crank and shaft, with provision at each end of same for a crank disc to be pressed on, and it is necessary that the crank pins be located 120 degrees apart.

The fixture consists of a frame or yoke of the shape of an inverted U, as shown at *Y*, Figs. 1 and 2. In the lower extremities of this frame are holes through which pass the rods *A* and *B*, which serve as guides for scribing tools, and both rods are adjustable through the yoke by means of the setscrews *R* and *S* to allow for different lengths of crank shafts. These setscrews bear against keys that rest in keyways cut on one side of each rod throughout its entire length, and the setscrews and keys are so set in the yoke that the keyway of each rod comes on its upper outward side at an angle of 60 degrees from the vertical. Each rod is supported at its end farthest from the yoke by a link or arm, as shown at *C* and *D*, which links have projecting centers that enter the centers in the ends of the shaft. The projecting center in link *C* is capable of adjustment in order to bring the fixture firmly into position against the centers. Each link is keyed onto its rod so that its axis passes through the keyway on the rod, making the links set at an angle of 60 degrees with vertical, as shown in Fig. 1. Then, in order to adjust the fixture vertically to bring the projecting centers in line with the shaft centers, the guide rest *E* is made adjustable through the yoke by means of setscrew *T*.

For carrying the scribers a sliding head is provided upon each rod, as shown at *F* and *G*, Fig. 2, with keyways and keys. To each head are bolted several scribers of shape shown in Fig. 4. These scribers are separated into two bunches upon each head, the two inner ones being just ½ inch apart; thus when they are swung down into position they will mark out a keyway ½ inch wide. Then, as the scribers are 1-16 inch thick, the next two outer ones will scribe a keyway ⅝ inch wide, and so on, the number of different sizes of keyways being determined by the number of pairs of scribers on the head. At *M*, Fig. 2, the head *F* is shown marking out a keyway on the gear seat. At each end of the shaft is a keyway for a crank disc. As may be seen in Fig. 4 the

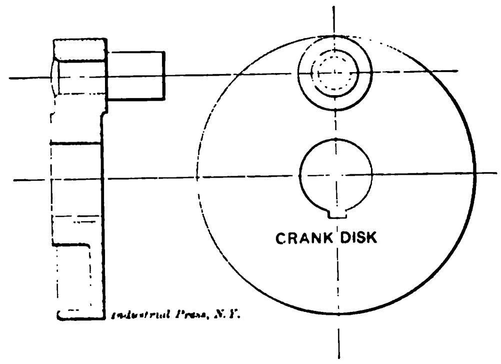


Fig. 3

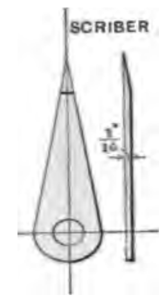


Fig. 4.

keyways in the crank discs are diametrically opposite the crank pins, so that after they are pressed onto the shaft the crank pins will come 120 degrees apart.

Holyoke, Mass. C. W. PUTNAM.

* * *

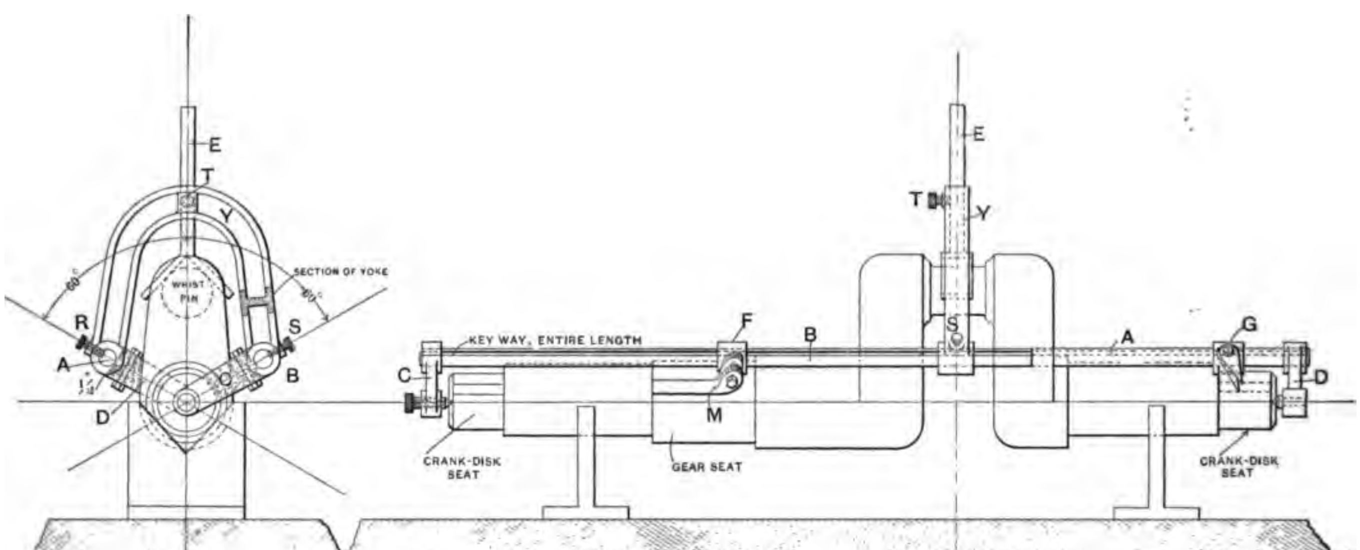


Fig.1 Fig.2

Laying out Keyways on Opposite Ends of a Crankshaft.

FORMED MILLING CUTTERS.

Editor MACHINERY:

The economy in time and accuracy of results obtained by the use of milling cutters, adapted to be ground without changing their shape, is very well known to mechanics, the cutting of gears and duplicating of irregular shapes in milled work having, indeed, become dependent upon them. However, the cost of a single cutter formed to a new shape is likely to be regarded as excessive, as such is necessarily special in its nature. Yet any shop possessing a lathe and milling machine need apprehend no excessive difficulty in producing satisfactory formed cutters at an expense little greater than that of ordinary milling cutters of corresponding sizes, provided they will do a little preliminary rigging-up for the purpose, as follows:

Every original form of cutter should have its template, shaping tool and lathe tool. The template may be a thin piece of sheet metal, preferably steel, having its edge worked to the desired form of the finished cut, either from a model or drawing. The shaping tool may be cast steel, with a shank to fit the fly tool holder of the milling machine, or the tool post of the shaper, its cutting end having a clearance angle of about 15 degrees from the top, or cutting edge. The cutting edge of this tool must be fitted accurately to the template, when the two are held in the same plane, and its depth of face must be enough to insure sufficient strength and rigidity to withstand making the cut upon the lathe tool. A piece of glass is convenient in fitting together the template and the tool, as it

enables both to be held readily in the same plane and allows the light to show progress in fitting together. The lathe tool should be machined all over to get the sides parallel and surfaces square with each other. Its cutting end will, of course, be made of sufficient width to fully cover the width of the cutter upon which it is to operate, and in order to work well it must be held square, both in receiving its shape, and in forming the cutter. The straight sides will aid materially in this and also in setting the tool at the proper angle with the shaping tool while its cutting face is prepared by it, and later in setting it radial with the cutter blank center. These steps are necessarily performed where the cutter is made, as

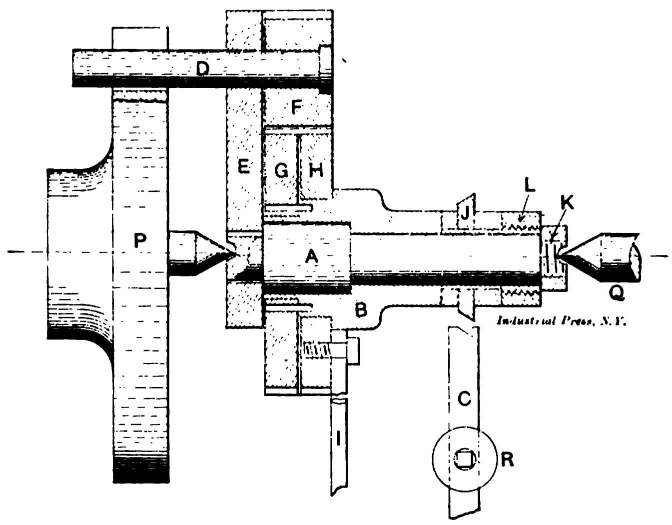


Fig. 1 Balzer Relieving Device.

also must be performed the preparation of the cutter blank, including rough turning to shape and the gashing of the teeth.

Occasionally a shop, driven by necessity, and at the same time recognizing the unreliability of hand-filed and scraped cutters, makes use of a special eccentrically-centered arbor, with a hand lever attachment for baking off, and backs off the cutters thus one tooth at a time. This is better than an attempt at filing, but it is hard work, and the lengths of the teeth are liable to vary as each tooth is independently finished. Further, as the cutter blank raises and lowers, by reason of the eccentricity of the arbor, the center of the cutter is constantly changing its position relative to the top of the lathe tool, so that the shape imparted to it will be modified by the throw of the arbor, and hence will not be exactly correct; neither will the tooth be quite the same at the point and heel, successive grindings showing a difference of cut, which is more perceptible in à cutter having considerable difference in its face outline than in one of a nearly uniform diameter.

The Balzer relieving device is an improvement over the plain eccentric arbor in some respects, as it performs the desired work automatically and uniformly, and the teeth are formed more nearly correct, as may be understood from the following description of the device. The diagram, Fig. 1, shows a sectional view of this apparatus as applied to an ordinary lathe, *P* being the faceplate and *R* the tool post. *A* is a shouldered arbor eccentrically centered to give the required amount of lateral motion, or throw, to the cutter blank *J*, to and from the tool *C*, by which it is formed, and relieved or backed off. The sleeve *B* turns freely on the arbor, between its shoulder and the nut *K*, and at its rear end is rigidly secured the gear *G*, while the loose gear *H* turns freely beside it. In practice, however, the gear *H* is kept from turning by the lever *I*, which rests on any stationary object, as the lathe bed or its carriage. The cutter, previously gashed, is held firmly between collars on the outer end of the sleeve *B*, which are clamped by the nut *L*. *E* is a driving lever secured to the arbor *A* and connected to it is the stud *D*, one end of which engages with the face plate, while the other end forms a bearing for the loose running pinion *F*.

It may be seen that if the gear wheels *G* and *H* had the same number of teeth, no motion would be imparted to them, or to the sleeve *B*, but the whole would have only the eccentric throwing action due to the arbor *A*. In practice *G* has the same number of teeth as *H* for about half of its circumference, but a few less on the other half; consequently the sleeve *B* and the cutter have a forward motion timed to take place when the eccentric action of the arbor throws towards the cutting tool.

The cycle of operation is as follows: Starting with the cutting tool at the front edge of a tooth in the cutter, the latter is slowly rotated forward, and at the same time moved forward bodily towards the tool until the next gap is reached; then the cutter stops rotating, but begins to recede from the tool until time for the cut to begin on the next tooth, when the operation is repeated. The lathe is thus running steadily forward all the time, making as many revolutions as the cutter has teeth, while the cutter revolves but once during the whole work of relieving all the teeth. The device is weak, for obvious reasons, and limited to a certain number of teeth, relative to the gearing employed.

The relieving device, shown in Fig. 2, can be applied to any ordinary engine lathe, with modifications to suit the varying conditions. As may be seen, it is extremely simple, consisting of a cam *S*, having one or more throws, fitted to the lead screw of the lathe and adapted to be driven by it, at any point along its length, as at the end of the carriage, or back of it underneath the apron, as may be preferred. Riding on this cam is a roller *T*, held in the lever *U*, to the outer end of which lever is attached a weight by means of the cord *C*. The other end of the lever *U* is secured to the short shaft *V*, supported by the brackets *W*, which are in turn fastened to the lathe carriage from beneath at *B*. Also on the shaft *V* is adjustably connected another lever *X*, forked at the top and engaging there between double flanged collars *Y* on the cross feed screw of the lathe in the place ordinarily occupied by a thrust nut, here temporarily removed. The common change gears for cutting threads are used in the same place and manner as originally designed. The brackets may be made a permanent attachment to the lathe, while the cam can remain on the lead screw without interfering in the least with its usual functions.

As the tool is, with this device, set at the height of the lathe center and as the device operates direct on the cross feed screw,

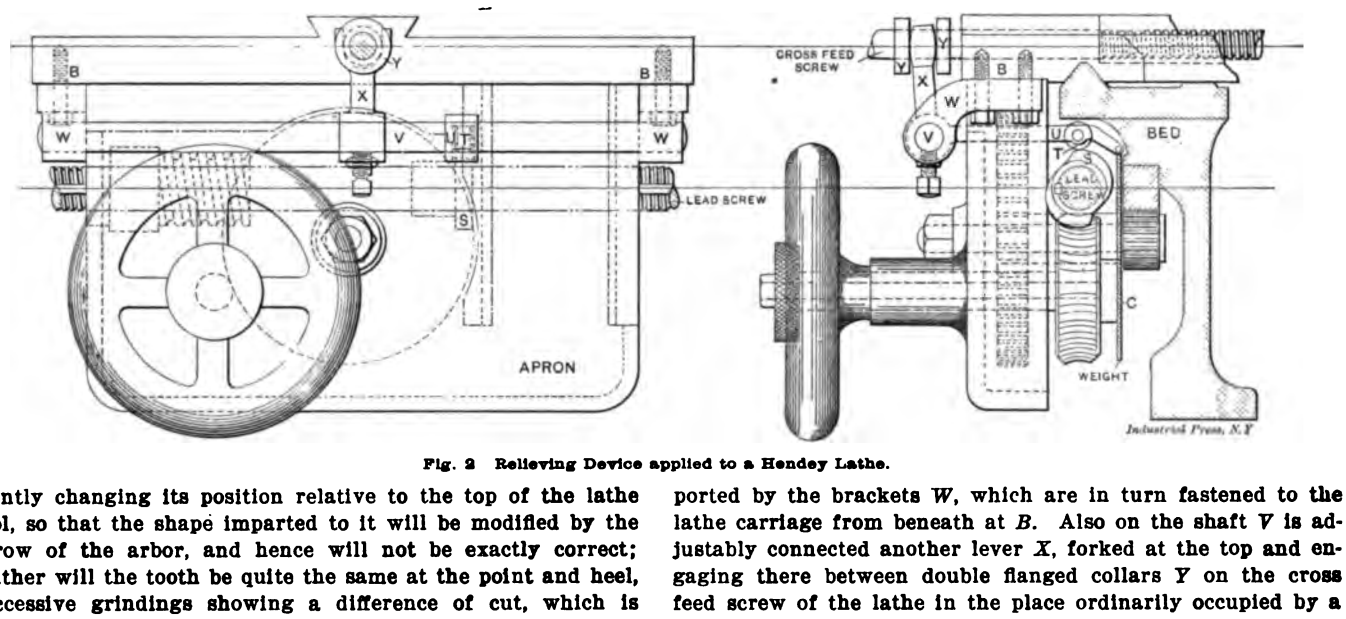


Fig. 2 Relieving Device applied to a Hendey Lathe.

the tool is caused to advance and recede in straight lines, according to the timing and shape of the cam, while the cutter-blank revolves steadily forward, as in common turning. In this way properly relieved teeth are assured, having exact uniformity and at only a trifling extra expense for the extra parts required. This device operates equally well on any size cutter and upon any number of teeth, limited only by the size of the lathe and the assortment of gears that can be used on it.

Philadelphia, Pa. W. E. WILLIS.

* * *

A NOVEL DRILLING JIG.

Editor MACHINERY:

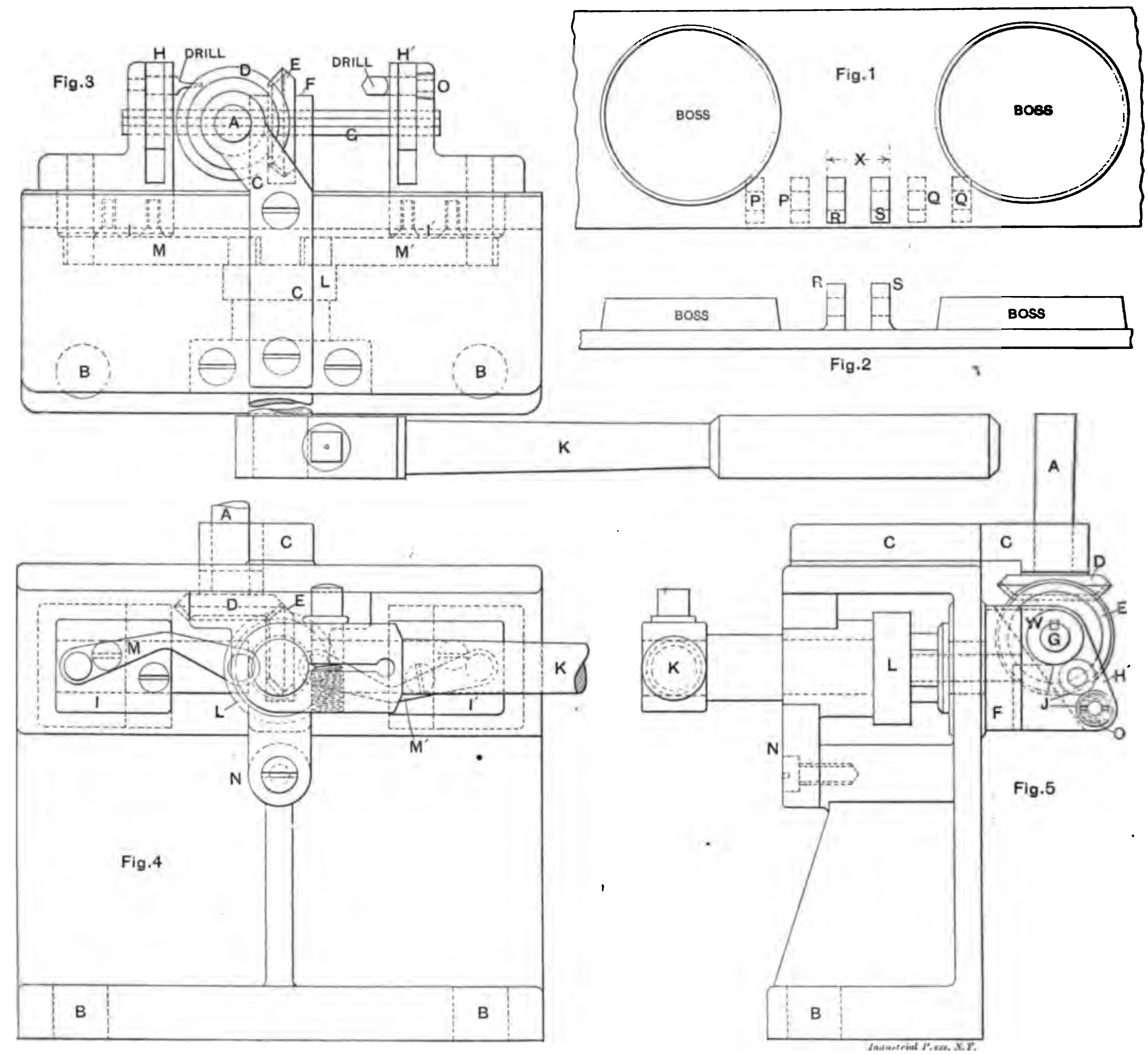
At one time the holes in the lugs *R* and *S* between the bosses on the castings, shown in Figs. 1 and 2, were made by coring in. The holes in these lugs are intended to receive pins which are riveted on both sides of the lugs, the pins serving as pivots for hinged screws. But, as may be imagined, they were often out of place and usually of varying sizes and conditions of smoothness.

Finally the lugs were cast solid and the device shown in Figs. 3, 4 and 5 was made to readily bore the holes in them. This device was constructed to be placed on the table of a drill press, and its spindle *A* to be entered into the drill chuck, the device being steadied by being bolted to the table through the holes *B B* in the base. The spindle A is supported by the bracket *C C*, and the lower end of the spindle is formed into a miter gear, the outlines of the gear cone being seen at *D*. This gear meshes with its mate *E*, which is supported on the shaft *G* by the bracket F, Figs. 3 and 5. This bracket *F* is fastened to the frame of the device by screws and pins and its outside width is equal to the distance between the lugs *X*, Fig. 1. It serves also as a bearing for the spindle shaft *G*.

The drilling heads *H* and *H'*, Fig. 3, are made to slide in slots in the frame and are gibbed into them by the plates *I* and *I'*, Figs. 3 and 4. Each head is slotted to receive the gear trains that drive the horizontal drills, the pitch lines of which gears are shown at *J*, Fig. 5. The lateral motion of the heads is obtained by means of the lever *K* acting on the disk crank *L* and through the links *M M'*, Figs. 3 and 4, the lever being supported by the bracket *N*, Figs 4 and 5. The lever is held by friction to allow adjustment for convenient working.

The links are so shaped to clear the shaft of the crank that nearly the full throw of the crank is available. This was necessitated by the fact that in some cases the lugs are placed alternately close to the bosses, as shown by dotted lines at *P* and *Q*, Fig. 1. For drilling the lugs in such cases one of the heads *H* or *H'* is removed and a drill long enough to pass entirely through both lugs from one side is put in the remaining head.

The drills used serve as spindles for the lowest gears in the heads. They have keys driven into their body and their ends are turned to enter *O*, Figs. 3 and 5, against which they shoulder. The trains of gears are protected from chips by thin sheet metal guards, not shown in the drawing. The driving spur gear *W*, Fig. 5, is keyed to, and receives its motion



Details of Drilling Jig for Operating on Casting shown in Fig. 2.

from, the splined shaft *G*. The heads, as shown in the drawing, are extended to the limit of their travel, but as used for drilling the lugs *R* and *S*, they close up until the drills just clear. So little room is there for working this device that the extreme outer ends of the heads had to be chamfered off to allow entrance to the work.

Brooklyn. J. R. GORDON.

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ANOTHER CRANK DISC, AND ANOTHER METHOD OF FINISHING THIN RINGS.

Editor MACHINERY:

I recently finished up a crank disc very similar to the one described in July MACHINERY, Page 365. I had the usual instructions to the effect that "No moss should grow on it."

I first bolted the disc to the face plate of the lathe with the pin side next to the plate, using parallels under it to block the disc out far enough to clear the pin. After truing up, I bored the hub and faced off the disc. To accurately center the pin and lay off the required throw, I drove an arbor through the disc till it projected out from the pin side of the disc the same distance as the pin. From the center of the arbor the center of the pin was easily determined to get the required throw. I turned the pin by bolting the faced side of the disc to the face plate with the center of the pin which had been located resting on the tail center of the lathe. In facing this side of the disc I had, of course, to shift the straps when half-way out on the work. By this method I had to center only one end of the crankpin.

If it were necessary to center the other end, my way would be to first place the disc on a planer platen with the pin resting on a V-block, as shown in Fig. 1. If the V-block was not tall enough it could be raised with parallels as at *P*.

First, center the outer end of the pin; then, taking care that the disc stands square with the platen, scribe the height of its center on the back of the disc with a surface gage. Next, revolve the disc upon the pin as an axis, and again transfer the height of the pin's center to the back of the disc; the intersection of these lines will be the rear center of the pin.* It is obvious that a strap will have to be placed on the pin to hold the disc in place. If the keyway in the disc is to be on the side diametrically opposite the pin it can be easily located with a center square by placing the center head on the pin and letting the blade extend across the hole.

In August MACHINERY I find that difficulties have been

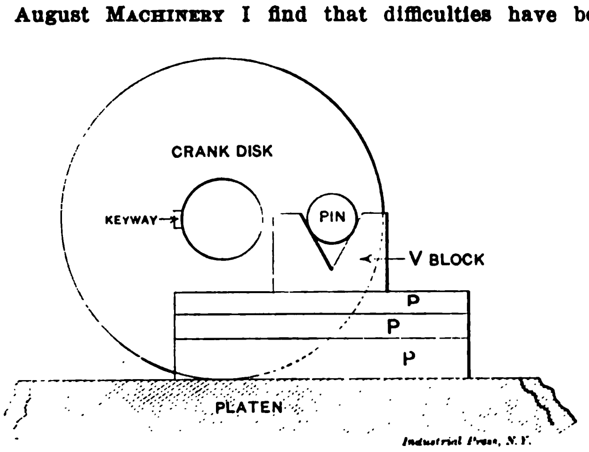
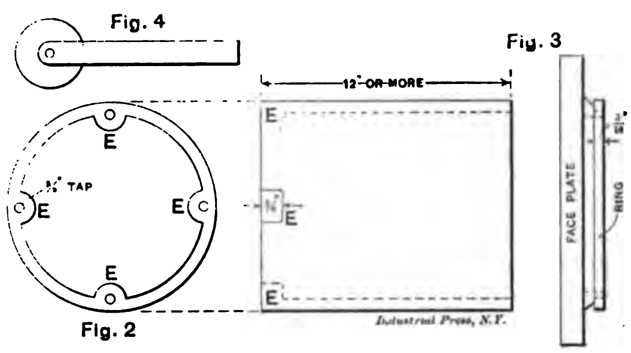


Fig. 1.

experienced in turning thin cast iron rings. The following is an easy method of doing such a job: Have a suitable number of ears cast on one end of the rough bushings from which the rings are to be made, either three or four ears only being necessary, according to the number of slots in the face plate of the lathe to be used. Fig. 2 shows how these ears *E* are to be arranged; they are to project inwards preferably and need not be over ⅝ inch thick. Face that end of the casting in a chuck and drill holes in each ear, and tap them with a ⅝-inch tap, and then bolt the end of the casting to the face plate with tap bolts. Turn and bore the casting to the required dimensions, and then face the edge and cut off rings about 1-64 inch longer than the finished size to allow for facing their inner sides.

When all but about an inch of the bushing is used up make an arbor of what is left to square the other sides of the rings on. The rings should go on this arbor as hard as possible and there should be a square shoulder to hold them true. Fig. 3 shows this arbor arrangement. Fig. 4 represents a roller which consists simply of a piece of steel of convenient size to fit in the tool post, and a roller mounted in one end. This tool is placed in the tool post and the



roller pressed against the ring on the arbor with the lathe revolving quite fast by means of which the ring can be pushed evenly against the square shoulder of the arbor. The rings can be easily removed with a pinch bar. If the distance from the shoulder to the end of the arbor is made exactly 3-16 inch the end will serve as a gage for setting the side tool. NEMO.

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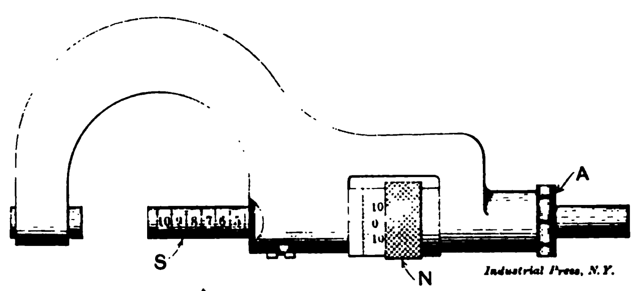
NON-REVOLVING SPINDLE MICROMETER.

Editor MACHINERY:

There occur cases in accurate measurements of work where the revolving of the measuring spindle of the ordinary micrometer is a disadvantage; in all kinds of measuring, in fact, the revolving of the spindle is never an advantage for obtaining fine measurements. The accompanying sketch illustrates a micrometer in which the thumb nut *N* revolves while the measuring spindle *S* does not, when being used for measuring.



Micrometer Caliper.

The thread on the spindle *S* occupies its middle part within the nut and is a 20-pitch of a special form. Because of being coarser than the ordinary micrometer thread (40-pitch), it is quickly operated, and also when the spindle is brought into contact with work it is with less pressure than in the case of the finer thread. Allowance for any lost motion in the threads of the nut and spindle and next to the shoulder of the nut is made by the adjustment nut *A*. The reading of size is made by lines and figures engraved (not stamped) on both the spindle and the nut.

There are many advantages in this arrangement of a non-revolving spindle which must be apparent to all who have had trouble with the ordinary revolving, or "crawling," spindle micrometer. In this type of micrometer the measuring spindle comes into a direct, natural contact with the piece to be measured. There are also essential features in the construction of thread and nut of this instrument which are not shown, but which contribute greatly to accuracy. However, the especial feature which I wish to emphasize is the value of the non-revolving spindle.

Springfield, Mass. F. W. CLOUGH.

* It is evident that the best results would be obtained by setting up the disk so that a line connecting the center of the pin with the center of the shaft would make an angle of about 45 degrees with the table.—EDITOR.

NOVEL COLLAPSIBLE TAPPING TOOL.

Editor MACHINERY:

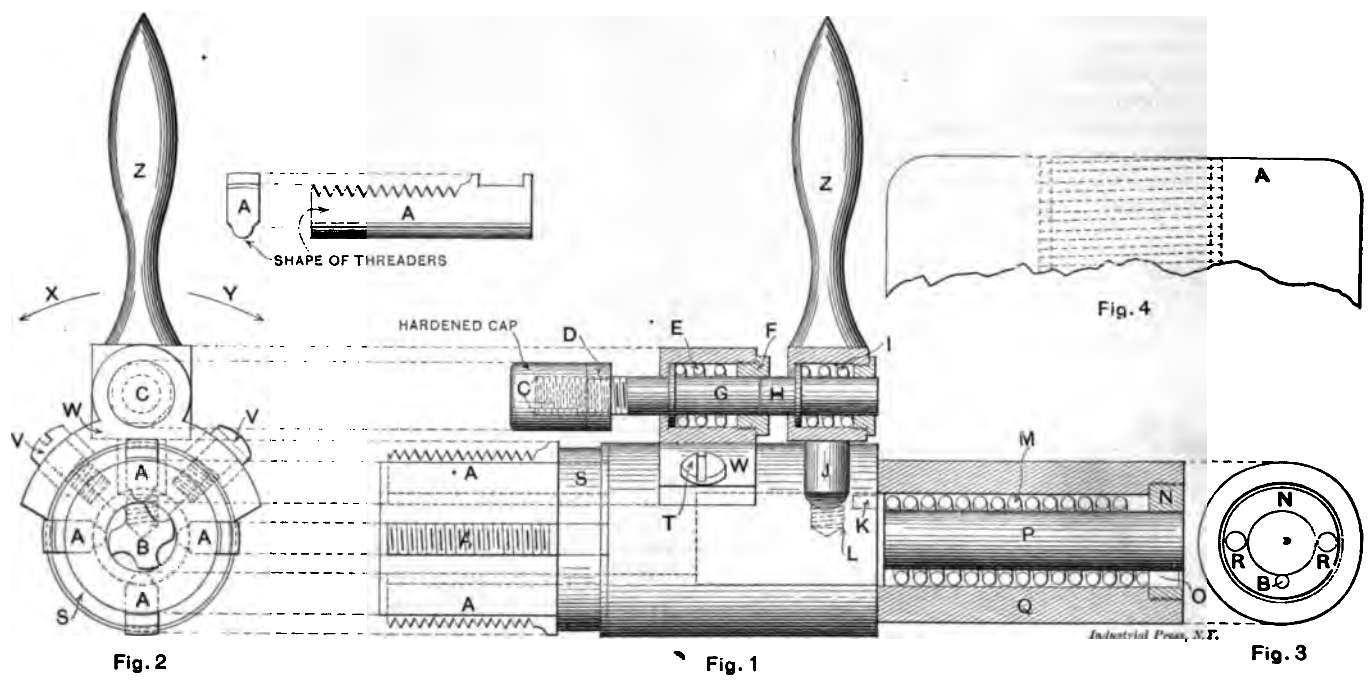
The tapping tool shown in the accompanying cuts, Figs. 1 and 2, is a tap designed to do away with the "backing out" of the tapped hole after the thread is cut, as is the usual practice; and also to provide adjustment of the cutters diametrically and to obviate the necessity of the operator attending to the collapsing of the tap. It is designed to tap holes in castings where there is a "boss," or deck, as at *A*, Fig. 4, which deck is made use of as a stop.

The operation of the tool is as follows: The tap enters the hole to be threaded and taps out the thread. When the hardened cap *C*, Figs. 1 and 2, strikes the surface *A*, Fig. 4, the shaft upon which the hardened cap is attached is pushed against the end of the shaft *H*, Fig. 1, which is locked into the hardened bushing *F*. This releases catch *H*, and the coil spring *M* forces the cam *B*, Fig. 2, around in the direction of the arrow *X*, bringing the grooves, or the smallest diameters, of the cam underneath the backs of the threaders *A*, Figs. 1 and 2. The band spring *S* then forces the threaders down upon the smallest diameter of the cam, which throws them out of action and the tap can then be drawn out of the hole.

The spring *M*, Fig. 1, in the shank *Q* operates as does an ordinary door spring. One end of the spring is fastened to the shaft *P*, on whose end cam *B* is milled. The other end of the spring *O* is held in a screw *N* which is provided with two holes—*R R*, Fig. 3—to receive a toothed or spanner wrench which enables the tension of the spring *M* to be tightened or loosened. By loosening the screw *T*, Fig. 1, and moving the piece *W* in one direction, as indicated by the arrow *Y*, the diameter of the tap is increased; by reversing it and moving it in the opposite direction the diameter is decreased. The body part of the tap is, of course, provided with an oblong hole, shown at *J*, to allow the handle *Z* the necessary amount of throw to move the cam from its largest to its smallest diameter. The tap can be set for different depths of thread to be cut by adjusting the hardened cap *C* along on its shaft *G* and tightening it by the jam nut *D*. After the tap is withdrawn the operator pulls the handle in the direction of arrow *Y* until the catch *H*, Fig. 1, engages in bushing *F*, both shaft and catch being actuated by the springs *E* and *I* respectively.

This tap is also provided with boring tools (not shown) dovetailed between each threader, for use on a drill press or turret machine provided with a leadscrew, enabling the boring and tapping of a hole to be done in one operation. When used on a machine without the leadscrew it is best, however, to use a separate boring tool.

Brooklyn, N. Y. GEORGE J. WINKLE.

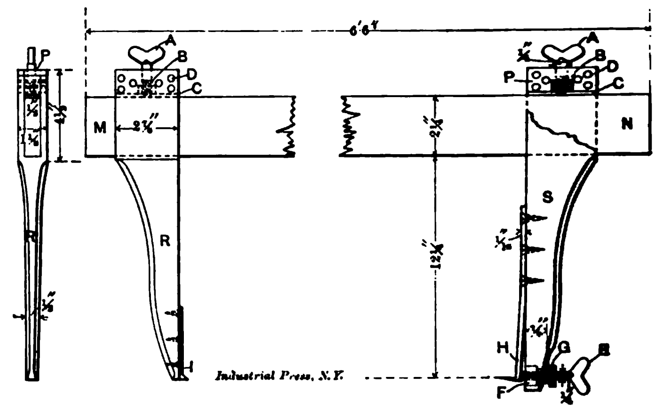


Details of Collapsible Tap.

LARGE BEAM CALIPERS.

Editor MACHINERY:

The accompanying sketch shows a large beam caliper designed for machinists and pattern makers. It consists of a beam *M N* and the legs *R* and *S*, made of cherry wood to the dimensions indicated. The legs are secured in position on the beam by means of the thumb screws *A*, which jam against the gibs *C* at the shoulders of the screws. The gibs have holes countersunk for the screws to enter, to hold them approximately in place, and the nuts *B* are of brass, fitted into the filling pieces *P* that keep them from turning. The filling pieces are riveted to the legs by means of cherry dowels *D*. One leg *S* is provided with a fine adjustment consisting of flexible steel spring *H*, ending in a point which is adjusted by the thumb screw *E*. This screw is locked in adjustment by the check nut *G* bearing against the brass nut *F*, which is inserted in the leg as shown.



Beam Calipers.

Holyoke, Mass. C. W. PUTNAM.

MECHANICAL DRAFT.

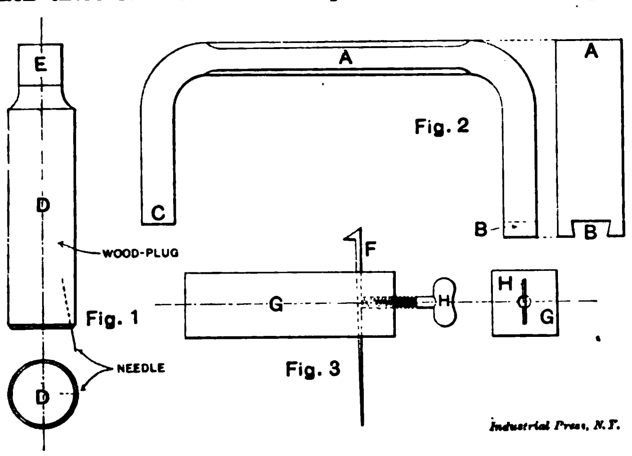
Mechanical draft is used extensively at the large shipbuilding plant of the Fore River Engine Co., at Quincy Point, Mass., an illustration of which recently appeared in these columns. The boilers have an induced-draft apparatus, the heating furnaces and forges are fitted with forced-system fans, and an exhaust fan removes the smoke from the hoods over the forges. All buildings are heated by the hot blast system, the warmed air being supplied through ducts which deliver it along the walls and above the head level. The buildings are fully exposed, yet during the past winter, the first since the plant was opened, a uniform temperature was maintained throughout all the buildings. The blower and heating equipment was installed by the B. F. Sturtevant Co., Boston.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

FILE HANDLE-SCRIBER INSTRUMENTS.

H. M. J. sends sketches of three devices that he has found to be handy. The one shown at *A*, Fig. 2, is a file holder for use on large flat surfaces where the whole file has to pass over the work. It was made of flat steel, about ¾ x ⅜ inch section, bent to the shape shown and the corners rounded off on the upper part at *A* so as to form a handle to grasp the frame by. A slot was cut at *B* on a taper so as to fit on the tang of the file, and also slightly tapering inward so as to more effectually retain the file. The end *C* of the handle is flat and simply rests on top of the file. The contrivance shown at *D*, Fig. 1, is convenient in laying off corresponding holes from a drill jig, or any drilled piece, onto a casting when there is a considerable space between the two pieces



at the place to be marked, or in a corner where it is impossible to get accurate results with an ordinary scriber. The plug *D* is turned out of hard wood to fit rather snugly into the hole to be transferred, but still loose enough to allow it to be revolved therein. The upper end *E* is flattened slightly to afford a handle, and into the opposite end a needle is inserted with the point left projecting out to act as a scriber. Then, by inserting the plug in the hole to be transferred as far as it will go and revolving it, a circle is scribed onto the casting concentric with the hole. If the needle's point projects out just far enough to be in line with the edge of the plug, the circle scribed by it will obviously be of the same size as the hole. Fig. 3 shows a handy and easily made gage which may be used for a variety of purposes such as depth gage, scribing lines parallel to the edge of work, etc. It is made of square steel of convenient size, and the scriber *F* is fastened in the hole through it by the thumb-nut *H*. A small hole drilled in the blade of a combination square to fit a similar scriber will also provide an instrument of the same nature and fully as handy.

JIG FOR FORGED CRANKSHAFT PIN.

W. T. S. sends a drawing of a novel jig for finishing the crankpin of a forged crankshaft without the delay of making

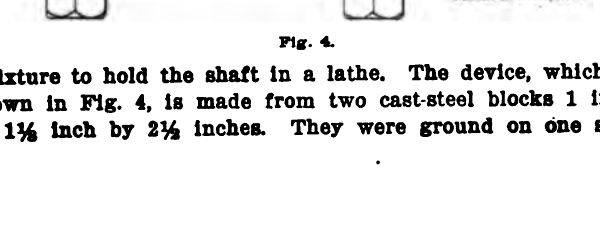


Fig. 4.

a fixture to hold the shaft in a lathe. The device, which is shown in Fig. 4, is made from two cast-steel blocks 1 inch by 1⅛ inch by 2½ inches. They were ground on one side to a bearing, dowelled together and clamped between two bars as shown. They were then bored out to a diameter equal to the required size of the pin, and teeth cut upon the inner periphery of the hole by the milling machine, after which the blocks were hardened. The jig, as may be inferred, is used as a cutter, the toothed blocks being clamped over the roughed-out pin, and then the shaft is centered in the lathe and slowly revolved. The cutter operates on the pin by being allowed to follow the crank-pin in its eccentric movement, but not allowed to revolve, and the desired size of pin is obtained by clamping the cutting blocks tighter together until they are firmly together, when the pin must be cut to size. Care should be taken that the roughed-out pin be evened up so that the hole in the block comes parallel with the axis of the shaft, and if the pin is longer than the width of the blocks the tool should be caused to slide back and forth along the length of the pin as the shaft revolves. W. T. S. suggests that this method may not be new to some, as it has been used in a modified way by a manufacturer of woolen machinery for several years, but it was new to him in this application and may be useful to machinists who are, like himself, building gas engines to run their lathes by.

TRICK GATE LATCH.

J. P. H. sends us a sketch of an ingenious arrangement of the common door latch for use on the machine shop gate to prevent strangers from walking in without permission. The device, which is shown in Fig. 5, resembles the ordinary thumb latch, or storm-door latch, except that the latch lever *A* is inverted from its usual position with reference to the catch *B*, and enters it from below, the spring *D* being used to hold it normally up into the catch. Thus, it may be seen

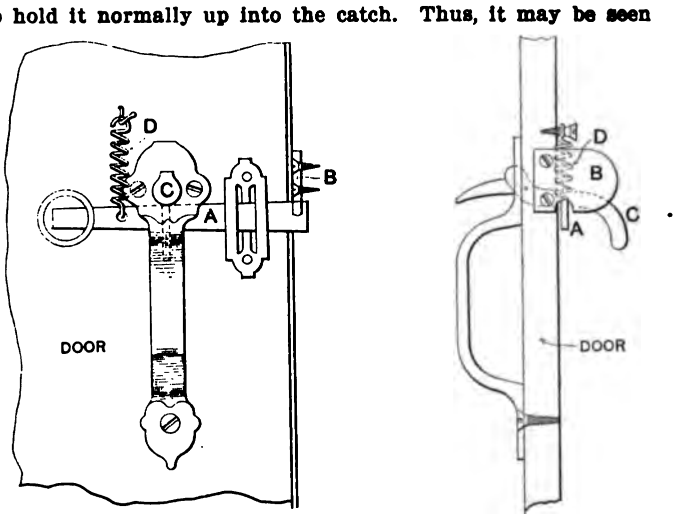


Fig. 5.

that, in order to unlatch and open the door or gate, it is necessary to push down on the bent end of the handle *C* on the latch side, or raise up the thumb end of the handle on the opposite side from the latch. This procedure is exactly in opposition to that usually met in such thumb latches, and for this reason a stranger will ordinarily be mystified and make so much noise in trying to get in as to attract the attention of those in charge.

GAGE FOR GRINDING DRILLS.

M. H. Ball, Watervliet, N. Y., sends a sketch of a gage for use in grinding drills, which he has found very handy and

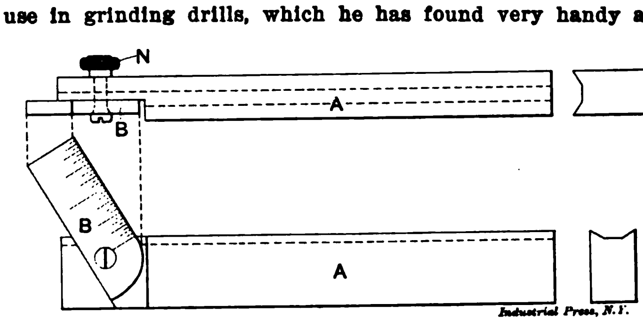


Fig. 6.

accurate. This gage, which is shown in Fig. 6, enables either a large or small drill to lie solidly in the groove provided for

it on top of the gage, and the lips can then be tested for their truth in width, or angle, much easier and quicker than with the gages in common use without the groove. There is a line, to set the blade *B* by, on the stock at an angle of 59 degrees at the top of the graduated blade, and the user can easily make other lines, if needed for special work.

The blade is clamped in position by the knurled nut *N* at the back and can be thus adjusted to any angle. The stock *A* is cut away where the blade is pivoted on, so that one side of the blade comes directly in line with the middle of the groove.

HANDY PLANER AND DRILL HOLDERS—BABBITTING PLATE FOR HANGER BOXES.

A. W. sends a sketch of a handy form of angle plate, which he calls the "lazy machinist's" angle plate. As may be seen in the sketch, Fig. 7, it consists of a rather large base plate with a vertical projection with holes for bolting the work

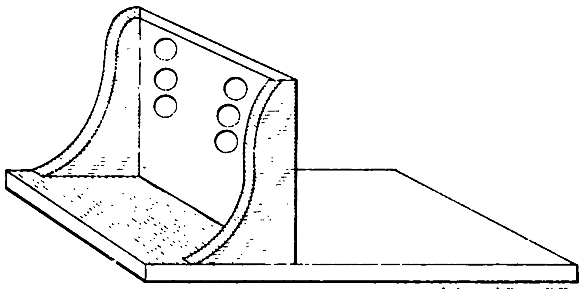


Fig. 7.

to. After the work is bolted to it the plate, work and all, may be moved to locate the work properly on the machine, thus avoiding moving the table.

He describes also a handy drill vise. An ordinary bench vise is bolted to a heavy plate, and then it is ready for use on the drill press, or for any similar work, having the great advantage of the saving of time over the method of clamping work in position. For very heavy work the base plate of the vise may be clamped down to the bed for additional stability of the work.

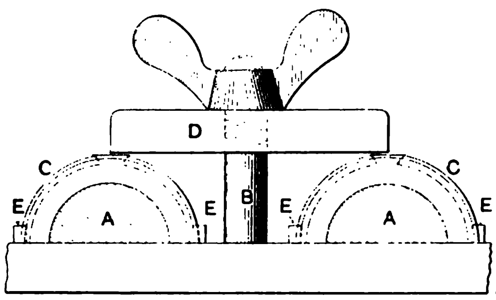


Fig. 8.

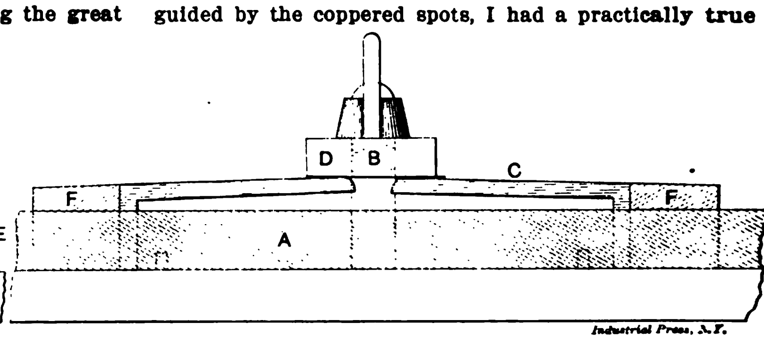


Fig. 9.

Another of A. W.'s kinks is a novel babbitting plate for hanger boxes, which is shown in the diagrams, Figs. 8 and 9. Two lengths of shafting of the diameter for which the boxes are intended are planed to one-half size, leaving half-round lengths of shafts, and fastened onto a plate flat side down and a short distance apart, as at *A*. Empty boxes are laid over the shafts upon the plate, as at *C*, Fig. 3, and separated and ended up by collars made to fit over the shafts, as at *F*. The boxes are guided into position by the pins, *E*, inserted into the base so as to insure evenly divided babbitting spaces inside the box and then the boxes are clamped in position by the clamps, *D*, and the bolts, *B*. Any cracks around the edges of the boxes may be puttied up and then the boxes are ready to pour. Two hundred boxes per day is the capacity of this device, the collars, *F*, being fastened to the base plate for easy repetition of the work.

GRINDING NARROW MILLING CUTTERS WITHOUT A CUTTER GRINDER.

Robt. Lachmann, Chicago, writes:

It is well known that, for a milling or slotting cutter to do good, rapid work, it should be true—that is, each tooth should be the same distance from the center of the wheel so that each one will do its share of the work. Having several cutters to grind frequently, and having no cutter grinder, I devised a method of grinding them that gives practically as good results as a more up-to-date grinder.

The method used is shown in the sketch, Fig. 10. First I clamped a piece of one-inch round cold-rolled steel to the rest on a dry grinder, as at *A*, using this size because all the cutters have one-inch holes. Then I slipped a cutter, *B*, upon this rod between the two collars, *C C*, which held it in position. By adjusting the rest with rod and cut-

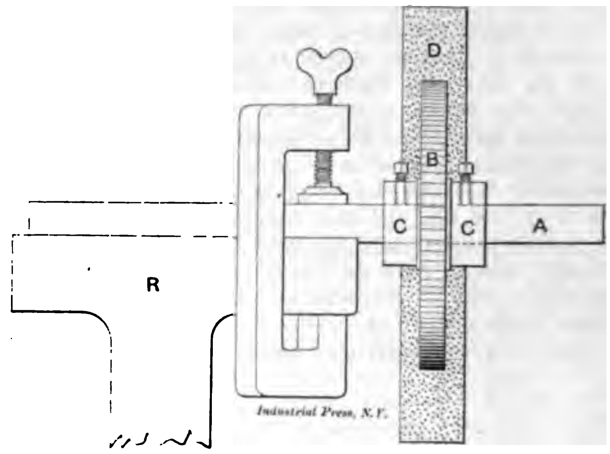


Fig. 10.

ter up against the emery wheel *D*, and revolving the cutter by hand, I "touched off" each tooth of the cutter, although as little as possible. Then I saturated a clean piece of waste with a solution of blue vitriol, and "coppered" the freshly-ground tips of the teeth, for reference in the operation of backing them off. Finally, I removed the cutter from the rod, and "backed off" the teeth for the necessary clearance by holding it horizontally upon the rest and being guided by the coppered spots, I had a practically true cutter.

LACING CUTTER.

S. M. Preston, Ouray, Colo., sends a sketch, Fig. 11, of an improved form of lacing cutter which he has made and finds to be more satisfactory than the common cutters. This cutter is an attachment for a pocket knife. On account of the small size of the blade, or cutter, usually used on the ordinary cutter, it is never sharp when it is wanted for use; while it is an easy matter to have one sharp blade in a knife. The addi-

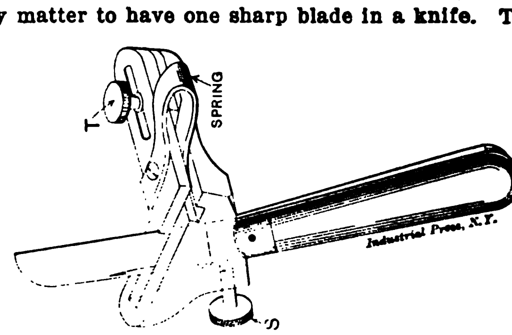


Fig. 11.

tion of the spring to press down and hold the string of lacing being cut is a great advantage as it makes the string all of one width whether thick or thin; whereas with the common cutter, the leather will double, if thin, and cut uneven or ragged edges. The frame may be cast iron or brass, and the spring may be either brass or steel. The knife blade is held firmly in the frame by a milled head screw *S*. The width of the lacing is adjusted by the sliding piece which is clamped by the screw *T*.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

The Western Machine Tool Works, Grand Rapids, Mich., have brought out a universal radial drill that involves some interesting features. It is a motor driven drill, but instead of the stepped cone method of varying the speed, a Reeves variable speed transmitter is connected between the motor and the drill spindle gearing. The motor is mounted upon the back side of the vertical column of the machine and the Reeves transmitter is located on top of the column. The column swings upon an inner post, the bearings for which are concealed, and the drill is provided with a tapping mechanism conveniently located on the arm.

NEW CALIPERS AND DIVIDERS.

The Brown & Sharpe Mfg. Co., Providence, R. I., have brought out a new line of spring calipers and spring dividers and of firm-joint calipers. Calipers of various designs have been on the market for so many years that a manufacturer who attempts to bring out a new line and who wishes to introduce improvements is confronted with difficulties quite as

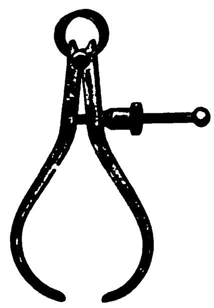


Fig. 1.

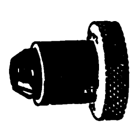


Fig. 2.

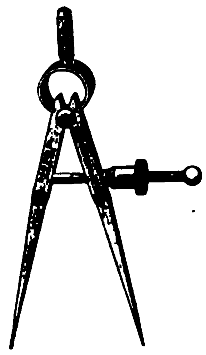


Fig. 3.

great as one would be in attempting to produce some more complicated tool. The most novel features of the spring calipers and dividers made by the Brown & Sharpe Mfg. Co. is the spring nut shown in Fig. 2. It is entirely new in design and is on the principle of a spring chuck with hardened jaws. The ends of these jaws are conical and a loose conical washer fits over them. When the leg of the calipers or dividers is free to bear against this washer, the jaws are thus closed together and the thread engages the screw. When the pressure is withdrawn the nut releases at once without regard to the manner in which it is held and can be slid freely along the screw, which latter is hardened.

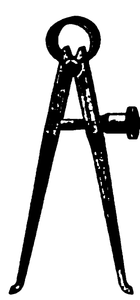


Fig. 4.

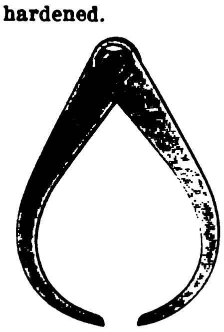


Fig. 5.

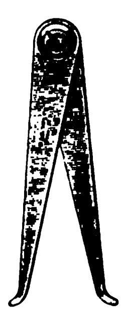


Fig. 6.

The spring is of improved form, unusually stiff and specially tempered. The ends of the spring terminate in convex lugs that fit in concave grooves milled in the upper ends of the legs. The construction is such that the spring is held firmly in place and that the legs are prevented from springing sideways, so that it is possible, for example, to describe a circle with practically no side deflection of the points. Both inside and outside calipers are made. The spring calipers and dividers are furnished in sizes from $2\frac{1}{2}$ to 6 inches, and the firm-joint calipers in sizes from 3 to 24 inches. The instruments are finished in the careful manner that characterizes all the tools made by this company.

IMPROVED UNIVERSAL RATCHET DRILL.

The Waterbury Tool Co., Waterbury, Conn., have recently introduced an important improvement upon their well-known Williams universal ratchet, in the way of an improved pivot bearing for supporting the ratchet case in the frame or handle. The new form of pivot bearings, which are shown diagrammatically in the accompanying drawing, consist of the pins *P*, which are inserted from the interior of the ratchet case *G* before the drill spindle *S* is placed therein, outward through the bearings and screwed into the holes in the ends of the prongs *F* of the frame, thus forming bearings for the ratchet case to rotate on within the frame. These pins *P* are locked, when screwed up to the final position, by the lock nuts

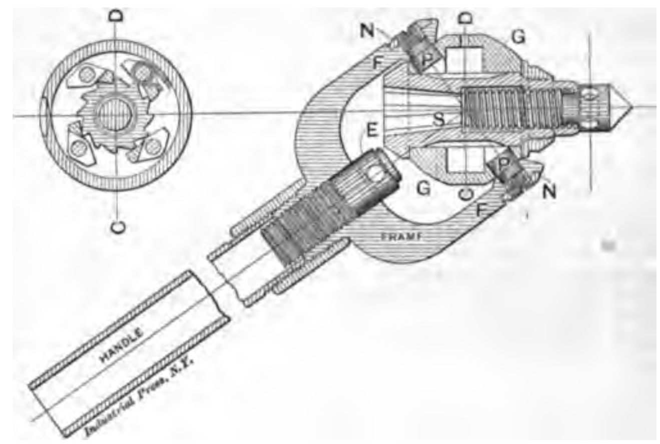


Fig. 7.

N to prevent them from working loose. This form of pivot bearing is one that offers very little friction and is devoid of the possibility of pressure causing binding, as was possible with the type of bearing previously used.

It will be remembered that this ratchet has the advantage that the handle may be moved in almost any direction whatever in drilling, by reason of the inclined position of attachments of the frame prongs to the ratchet case. A back-and-forth motion of the handle in any direction for about 2 inches will operate the drill, while by setting the screw *E* in the handle in one of three countersinks in the outside of the ratchet case, a rigid handle is secured. There are four pawls in the ratchet case and twelve teeth, so that 48 catches are possible in one revolution. These two features make it a very valuable tool for use in restricted spaces and in positions not readily accessible for ordinary drills or wrenches, and as the parts of this drill are steel drop forgings it is capable of withstanding a great deal of hard usage.

* * *

In a discussion of the Parsons steam turbine for marine purposes before the Institution of Engineers and Shipbuilders in Scotland, several questions were asked about the action of steam when used in a turbine, particularly when the steam was superheated. In reciprocating engines the effect of superheated steam is to minimize condensation in the cylinders, but in turbines the gain cannot be attributed to this cause, and it was desired to know why superheated steam improved the economy of the turbine as well as of the reciprocating engine. It was also desired to know to what extent superheated steam would cause deterioration of the turbine blades and how much condensation occurred in the turbine through the conversion of the heat in the steam into work.

In reply Mr. Parsons said that many of his steam turbines had been in use with superheated steam for the past three or four years, and no deterioration of the blades or surfaces was observable. In some cases a superheat of as much as 150 degrees Fahrenheit above the temperature of the boiler had been used. Generally speaking, a superheat of 50 degrees Fahrenheit reduced the steam consumption by 9 per cent, and a superheat of 100 degrees Fahrenheit by about 12 per cent. At full powers the steam became saturated after a portion only of the expansion, the exhaust steam being saturated, but at light loads the steam was superheated throughout right into the condenser. The diminution he had stated arose partly by annulling of liquid skin friction and partly by the great volume and intrinsic energy of the steam.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

6. E. W. M.: 1. What is meant by the expression "circular mils," as applied to electric wires? 2. Is the carrying capacity of a wire affected by its length? 3. What determines the voltage that will be delivered by a dynamo?

A.—(1) The circular mil is the unit of circular area which is used by electricians as a basis of calculation for the cross sections of wires. The number of circular mils of area of any wire is equal to the square of its diameter in mils. A mil is 1-1000 inch. (2) No, not unless it is wound into a coil. (3) Three factors go together to determine the voltage: The number of wires on the armature, the strength of the magnetic field, and the speed at which the armature revolves.

7. R. N.: Referring to Grant's method for laying out the curves for cycloidal gear teeth, as given in the data sheet issued with the September number, I do not understand the directions for 10 and 12-teeth gears. In the table giving the distances of the line of flank centers from the pitch line and the length of the radii for drawing the flank of the tooth, the minus sign and also the sign of infinity are used. What do these signs mean in this connection?

A.—The minus sign shows that the line of flank centers must be drawn inside of the pitch line instead of outside, as shown in the chart; and that the flank center must be taken on the opposite side of the tooth from that shown, which will give a convex instead of a concave flank. The signs of infinity simply mean that for a 12-tooth pinion the flank will be a curve of infinite radius, or in other words, a straight line. This line will be a radial line.

8. W. H. H.: Will some machinist or foreman tell me a good way to bore long cylinders and get the bore straight? For example, in boring a cylinder 8 inches diameter by 10 feet long, with a traveling head on the boring bar, I found the hole to be 1-16 inch under size in the middle. The cutter head had three tools and was steadied by six hickory blocks standing on end in the head. A star feed was used. 2. Please give directions for sweating two half boxes, or brasses, together so they may both be planed at one time.

A.—It is a difficult matter to bore a long hole with a boring bar and traveling head and we should expect the hole to be larger in the center than at the ends, instead of smaller, as stated by our correspondent. The best results in boring long holes are obtained by a bar with a cutter on one end and where the work rotates instead of the bar. In such a case a packed bit is used or else a bit having a single cutting edge and a shank of the same diameter as the hole, so that the cutting edge will be firmly supported and accurately guided by the part of the hole that has been completed. We submit the question to our readers and ask that any who can give practical information will kindly do so. 2. The process of sweating parts together is practically one of soldering without the use of a soldering iron in the ordinary manner, the parts being fused together at a comparatively low temperature by the use of soft solder. The parts to be sweated together are coated on the opposing faces with a thin coating of solder, which process is commonly known as "tinning." To tin the parts the faces must be clean and free from grease and a flux should be used to facilitate the action, ordinary tinner's acid being good to use on brass parts. The tinning is done with the pieces at the melting point of solder which enables each face to be covered with a very thin thickness of solder and all excess to be easily removed. A Bunsen gas burner is a convenient heater to use on comparatively small pieces. After the pieces have been tinned, they are laid together in the position desired and clamped. The heating is continued until the solder is known to be in a liquid condition when the parts may be quenched in cold water. The whole operation is not much more difficult than ordinary soldering and with a suitable means of heating it may be quite quickly done.

9. L. H., Paris, France: In truing up small emery wheels, used for grinding cutters, my workmen prefer to dress the wheel with an old saw, claiming that it gives a porous surface well suited for grinding, while a diamond cuts off the hard parts. I prefer to dress the wheel with a diamond. Which is right? 2. When cutting spiral milling cutters, what is good practice for the pitch of the helix, taking into account the length and diameter of the cutter? Is is preferable to use different pitches where the cutters are to be used on different metals?

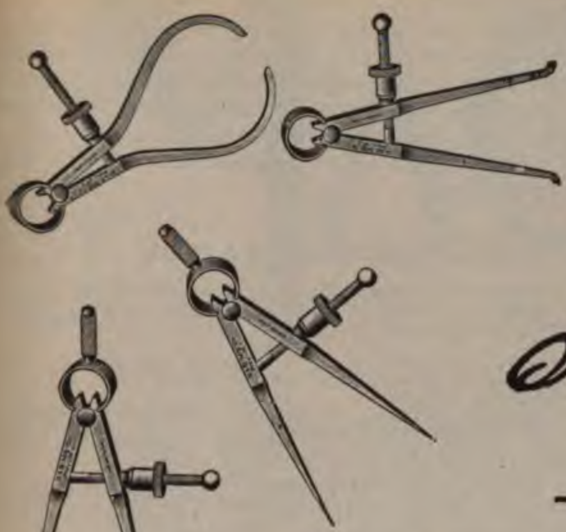
A.—We referred the first question to the Norton Emery Wheel Co., Worcester, Mass., who write as follows: "The usual method of dressing soft, thin or delicate wheels is with a diamond, because it can be done much quicker and to much better advantage this way than any other. We think that what your correspondent says is true, that the diamond cuts the grains and leaves a smooth surface which would not cut as freely as it would if dressed with a piece of steel or revolving cutter. We should say that if he were able to use a piece of old saw, and if the results of this are satisfactory he should by all means continue. We use revolving steel cutters in our own works and recommend them for others in every case where they can be used. 2. The second question was kindly answered by Gay and Ward, Athol, Mass. as follows: It happens that we, as manufacturers, are now engaged in establishing a pitch of spiral for milling cutters ¾ inch thick to any required thickness. From ¾ inch to 1½ inch thickness of cutter we have adopted 20 degrees to 25 degrees pitch of spiral, and for cutters 1½ inch face and wider 22 degrees. For circular pitch of teeth the following represents our standard at present: Milling cutters 2½ inches diameter, 7-16 inch circular pitch of teeth; milling cutters 3 inches diameter, 7-16 inch circular pitch of teeth; milling cutters 3½ inches diameter, ½ inch circular pitch of teeth; milling cutters 4 inches diameter, ⅝ inch circular pitch of teeth; milling cutters 5 inches diameter, ⅝ inch circular pitch of teeth; milling cutters 6 inches to 10 inches diameter, 11-16 inch circular pitch of teeth. We make no distinction in pitch of spiral, or teeth for milling the different metals. Where it is found necessary to change our standard in order to produce better results, such cutters should be made to order and are classed as special milling cutters. The conditions governing the use of milling cutters, such as hardness of material to be milled, the rigidity of the work governed by the fixtures designed for holding same, and the class of machines on which the cutters are used preclude any formula other than above described. In our works it has been found that a decided departure from pitch of spiral and number of teeth has produced results under certain conditions far in advance of what could be obtained with so-called standard cutters.

* * *

Among the most fruitful causes of friction between railroads and their patrons is the delay in the payment of small claims for damage to freight, losses, etc., frequently running into many months. The ordinary shipper, being ignorant of the causes of this delay and righteously indignant is not inclined to look with favor upon any of the excuses offered by the railway companies, his idea being that they purposely retain the money for use. Comparatively few men outside the railroad business understand the causes for this delay, which at best is sometimes protracted and often unduly extended. It is, of course, true that some roads have on occasion put off payment as long as possible by a judicious use of the subterfuge of "red-tape," but that is a practice which has been abandoned by most roads. Railroads are now rather seeking to devise methods for the quick payment of claims. The Atchison, Topeka & Santa Fe inaugurated a practice on August 1 which is a distinct step in advance. That road has for a long time instructed its agents at receiving stations to pay upon sight any overcharge claim that was evident on its face, and on the date above mentioned it authorized its Auditor of Freight Receipts to pay by draft, any loss, damage or overcharge claim not exceeding fifty dollars, as soon as the proper papers were submitted, examined and found correct. This will make it possible in many cases to pay the claim by return mail, and will go far toward adding to the popularity of that road with the shipping public.

* * *

Never try to caliper a piece when it is in motion, especially when using snap gages or micrometers, and never try to force gages over work when they fit too tight.



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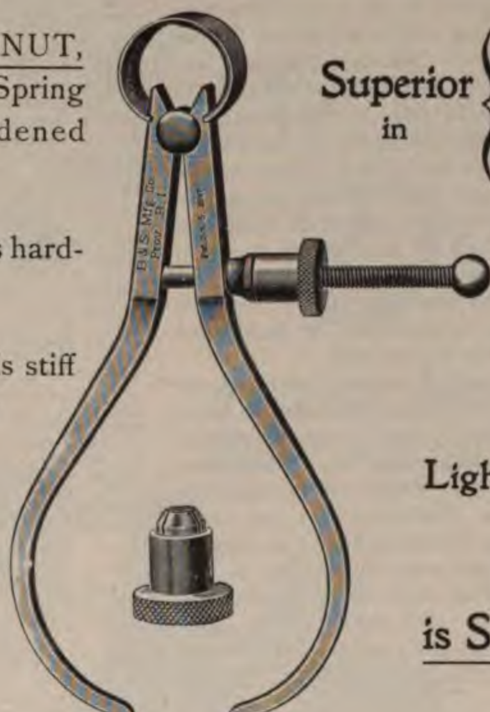
THE SPRING NUT, new in design, is a Spring Chuck with Hardened Jaws.

THE SCREW is hardened.

THE SPRING is stiff and of Improved Design.

THE LEGS are Steel Drop Forgings.



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Light, but Substantial.

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EXTENSION OF THE SNOQUALMIE FALLS POWER COMPANY'S INSTALLATION.

Of all water power plants in existence, this hydro-electric installation with its underground generating station is probably one of the most interesting. During the last six months it has been visited by engineers from all over the world who testify to the excellence of its design and operation, the entire load of the system, with its varied service, including electric traction, mill and factory power, and electric lighting, being operated in multiple, with a voltage regulation of within two per cent.

Only two years have passed since the current from Snoqualmie Falls was first carried into the cities of Seattle and Tacoma, Washington, but in this short time the initial installation of 8,000 horse power has proven too small and the capacity of the plant is to be enlarged to meet the increased demand for power in these growing western cities. At the falls, distant 44 miles in an air line from Tacoma and 32 miles from Seattle, are now installed in a rock excavated chamber 270 feet below the surface of the ground four electrical generating units, each consisting of a water-wheel direct-connected to a 2,000 H. P. Westinghouse three-phase alternator. This power transmission system now generating and distributing 8,000 electrical horse power is to be more than doubled in capacity.

It is proposed to carry, at the same transmission voltage now employed, which is 30,000 volts, 12,000 horse power more into the cities above mentioned, making the total output of the plant 20,000 electrical horse power. The new electrical machinery to be installed is to be furnished by the Westinghouse Electric & Mfg. Co.; and the Abner Doble Co., San Francisco, Cal., who furnished the water wheel equipment for the initial installation, are figuring upon a contract to place their wheels in the new extension. If an impact wheel is used there will be a single wheel on each end of each generator shaft and each wheel will be driven by a single jet of water 14 inches in diameter, the two jets combined being sufficient under the existing head of 270 feet to give the requisite power. The two water wheels and the generator between will be built on a single hollow shaft of oil-tempered nickel steel.

The present underground generating station, which is 200 feet long, is to be lengthened out 150 feet up-stream to make room for the new installation, and a new penstock is to be built of a size sufficient to carry 50 per cent more water than the old one. The transmission line, which will parallel the old line, will require 125 tons of aluminum wire, the order for the aluminum having already been placed, and at Tacoma a large and commodious brick and stone sub-station is now being erected. The entire cost of all these improvements will be in the neighborhood of $400,000. The work is to be vigorously prosecuted and it is expected that the first of the new generators will be delivering current into Seattle and Tacoma within the next nine months.

The generating machinery will consist of three 3,000-kilowatt rotating-field generators of the two-bearing type, generating a three-phase current at 1,100 volts and 7,200 alternations at a speed of 100 R. P. M. Each generator will require an exciting current of 320 amperes approximately, at 125 volts. For exciting these three generators a 200-kilowatt, eight-pole, direct-current generator of the two-bearing type is to be used, which at a speed of 175 R. P. M. is to deliver under normal load a current of 1,600 amperes at 125 volts. The three-phase current which is generated at 1,100 volts is to be raised to a line potential of 30,000 volts by nine 1,000 kilowatt, oil-insulated, water-cooled transformers, which are to be delta-connected on both the primary and secondary sides. It is estimated that each transformer will weigh 11,000 pounds and require 500 gallons of oil.

The switchboard that is to be installed is to consist of fourteen panels of white marble and is to be of the special type that was furnished for the original installation. However, instead of the Niagara type of single-phase indicating wattmeter that is in use on the present switchboard, a polyphase long scale indicating wattmeter is to be used, and where formerly a field plug switch was used a double pole field switch is to be employed. The former standard equipment of synchronizing lamps is to be replaced by a single-pole plug-switch mounted on the generating panel and connected to a synchroscope which will be mounted on the multiplying panel. The increased capacity of the generators will necessitate placing three single-pole main switches instead of one three-pole main switch. The circuit breakers, which are to be [illegible] automatic, will be placed on an extension panel above the main instrument panel.

* * *

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Standard Tool Co., Cleveland, Ohio. Catalogue of drills, taps, taper and shell reamers, and drill chucks, printed in the Spanish language.

E. W. Bliss Co., Brooklyn, N. Y. Illustrated catalogue of drop hammers and trimming presses, with views of various types of the Stiles automatic drop hammer.

Chicago Pneumatic Tool Co., Chicago, Ill. Catalogue illustrating their long-stroke air hammers, Boyer piston air drills, Duntley piston air drills, Phœnix rotary drills, compression riveters, etc., and numerous views of these tools in actual use on heavy work.

The B. F. Sturtevant Co., Boston Mass. Illustrated catalogue of steam hot-blast heating and drying apparatus, consisting of heating coils, blow-through heaters, hot-blast fans, etc., together with the necessary auxiliary apparatus, as steam traps, pump governors, etc.

The Danielson Machine & Tool Co., Cleveland, Ohio. Advance catalogue, with partial list of their power presses of the inclinable open-back type, and also their power punching presses and [illegible] forming machine.

Hilles & Jones Co., Wilmington, Del. Catalogue of machine tools for working plates, bars and structural shapes, illustrating various types of punching and shearing machines, plate-bending rolls, plate-planing machines, and numerous special machines.

The Roller Bearing and Equipment Co., Keene, N. H. Illustrated catalogue of ball thrust bearings, grooved ball shaft bearings, roller thrust bearings, and roller bearings of all kinds, complete with bushings and shells. Also a new line of roller side bearings for railway car trucks is now being made, as well as the center bearings.

J. H. Williams & Co., Brooklyn, N. Y. Catalogue of iron, steel, copper, bronze and aluminum drop forgings, which is the exclusive output of the factory. A great variety of drop-forged wrenches of all kinds, handles, hooks, and also solid forged crankshafts and other difficult forgings are illustrated.

The Bradford Machine Tool Co., Cincinnati, Ohio. Illustrated catalogue of the Bradford engine lathes, with views of the various attachments, such as taper attachments, double back gearings, compound screw-cutting, etc., and also of their line of automatic power-feed turret lathes and attachments.

Bullock Electric Mfg. Co., Cincinnati, Ohio. A number of the latest bulletins issued regarding Bullock apparatus, direct and three-phase current, and direct motor-driving installations, including Bulletin No. 28C, descriptive of the Bullock electric power system for operating newspaper presses with the "teaser" method of control.

The Turner, Vaughn & Taylor Co., Cuyahoga Falls, Ohio. Catalogue of wire and chain machinery, including the entire equipment of rod and wire plants, nail factories, welded chain plants, etc.; views of several installations and many types of the necessary special machinery being given.

The Northern Mfg. Co., Madison, Wis. Catalogue, No. 24, of shop and tool equipments, with Northern motors. This is one of the most complete catalogues upon the subject of electric driving that we have received, and should be in the hands of those interested in the subject. It is profusely illustrated, the methods of driving individual machines being shown, as well as views of the complete machine works where electric driving is used. At the back of the catalogue are articles reprinted from several technical papers touching upon electric driving in various lines of work.

MANUFACTURERS' NOTES.

The Ball Bearing Co., Boston, Mass., inform us that they have lately been so rushed with orders that they started to run a night force in the latter part of August.

W. H. Vance, formerly connected with the Sterling Emery Wheel Mfg. Co., Tiffin, Ohio, has been made superintendent of the factory of the Star Corundum Wheel Co., Detroit, Mich.

For the description of the method of tempering by the use of beef tallow bath in connection with gas furnace, described on page 45 of the current number, we are indebted to the catalogue of the Chicago Flexible Shaft Co., Chicago, Ill. Acknowledgement was inadvertently omitted.

The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., have recently completed a brass rolling mill for the Holmes, Booth & Haydens Co., Waterbury, Conn., and also a heavy hydraulic press, and a double electrically-driven triplex hydraulic pressure pump which is to be used at the new U. S. Mint, Philadelphia, Pa.

The American Blower Co., Detroit, inform us that their factory is operating to its full capacity. Orders were recently received for apparatus for public schools in six cities of Pennsylvania, in New York City, in Bridgeton and Tome River, N. J., and other cities. They have also orders from other schools and public buildings, besides a number for factory heating, drying apparatus, etc.

The Cincinnati Planer Co., Cincinnati, Ohio, have completed a new addition to their plant, and are now putting in the equipment of machine tools, which includes several planers of their own make, a 36-inch automatic gear cutter, a universal grinding machine, a horizontal boring and drilling machine, and several engine lathes.

The Crane Co., Chicago, Ill., have this summer erected at their works, at Jefferson, Van Buren and Desplaines Sts., a foundry which is to be devoted exclusively to heavy work, i. e., flanged fittings and large valves. This new foundry, they say, will increase the Crane Co.'s capacity for heavy work about 50 per cent. It is a one-story brick building, and has two cupolas, an electric traveling crane and other modern conveniences. It is expected to be in operation in about 30 days.

The Reeves Pulley Co., Columbus, Ind., state that they are much rushed in their variable-speed transmission department, and have been all season. They are adding to their transmission department a one-story brick building 112 by 56 feet, with a traveling crane and concrete floor, for the installation of the heavy machinery used in building their larger sizes of transmission. They hope to have the machinery running by Nov. 1. They also say this has been a banner six months in the pulley business. They are now finishing a main driving pulley, 16 feet in diameter, 31 inches face, weight guaranteed of 12,000 pounds, built entirely of Southern Indiana oak.

DOMESTIC EDITION.—ADVERTISING INDEX PAGES 35-37.

MACHINERY

VOL. 8. NOVEMBER, 1901. No. 3.

PUBLICATION OFFICE 9-15 MURRAY STREET NEW YORK

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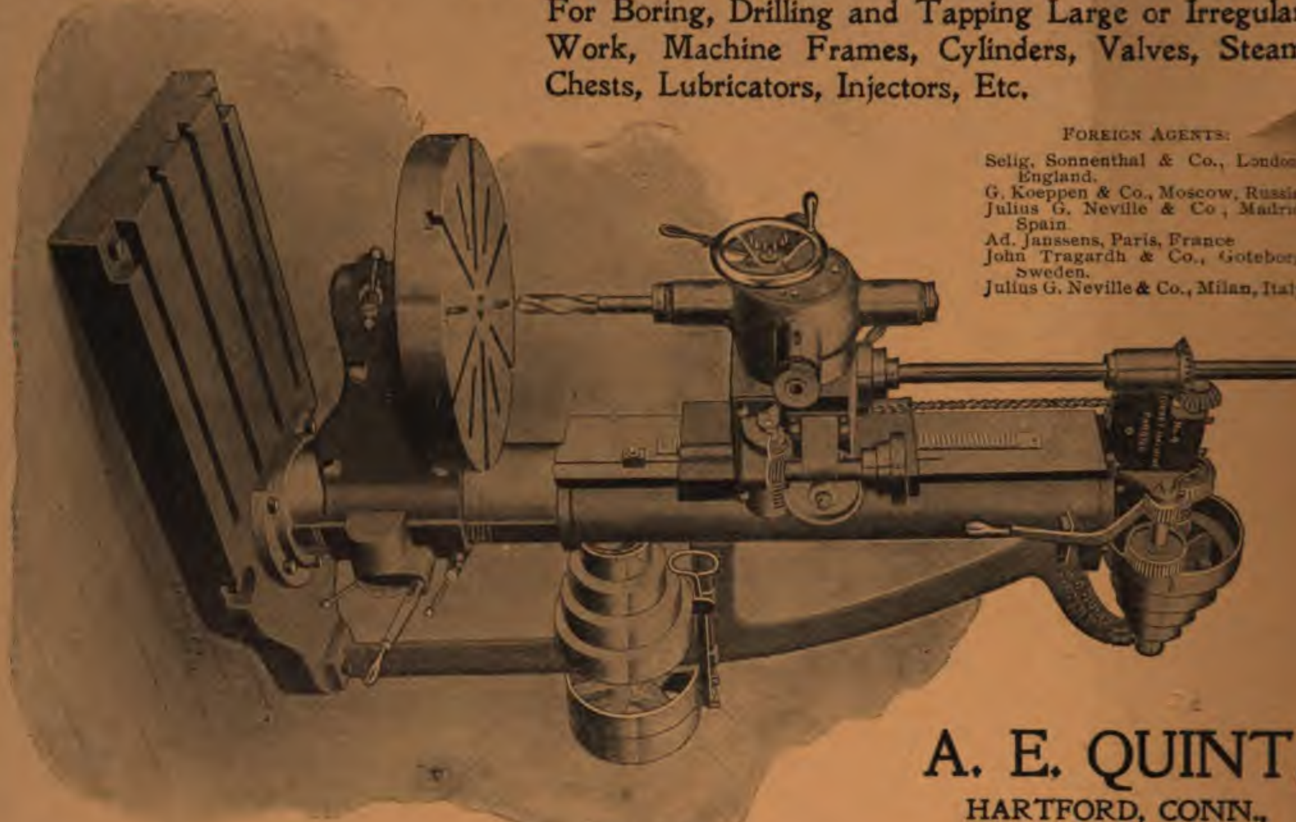

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Warp: Drop-forged. Selected steel. Perfect design. Greatestweight. Adequate strength.

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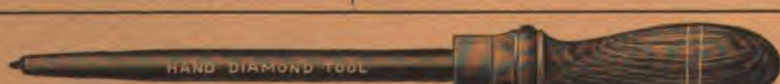


THOS. L. DICKINSON, 45 Vesey Street, New York City.

MACHINERY.

Vol. 8. November, 1901. No. 3.

TOOLS FOR MACHINING PULLEYS.

DETAIL SKETCHES OF TOOLS AND FIXTURES FOR USE IN THE TURRET LATHE.

JOSEPH VINCENT WOODWORTH.

The set of tools of which sketches are here shown were designed for finishing countershaft clutch pulleys in the turret lathe and have been very successfully used for this purpose. It was desired to turn out the pulleys in large quantities, and to have the work accurately done, making them duplicates so far as their finished dimensions were concerned. The tools were so constructed that the pulleys could be finished complete at one setting.

The type of pulley which this particular set of tools was designed to machine is shown in the two views in Fig. 1, and consists of a six-arm pulley of a common type. The points to

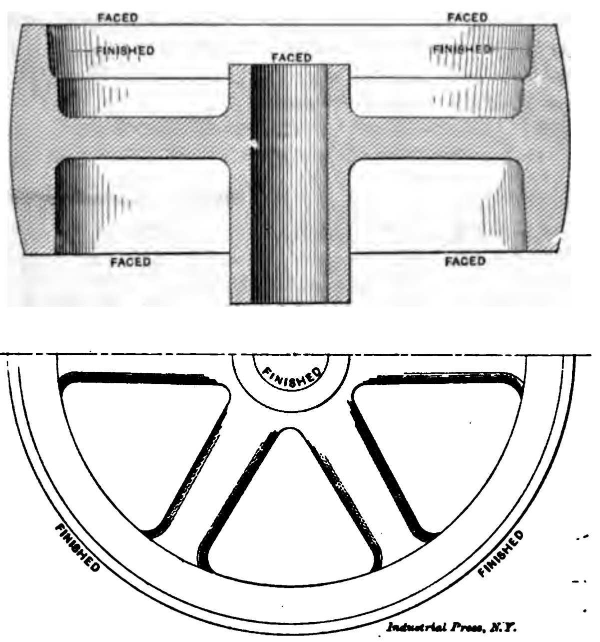


Fig. 1. Countershaft Clutch Pulley, showing Surfaces to be Machined.

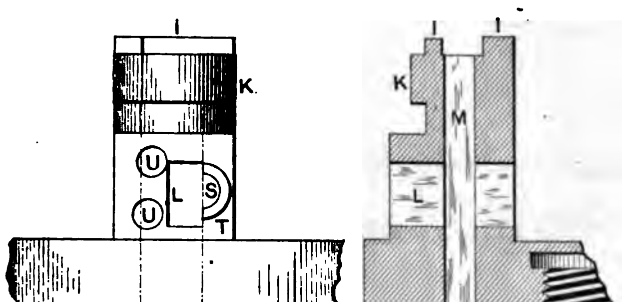


Fig. 3. Details of Body of Chuck, showing Broached Holes for Jaw and Wedge.

be machined are as follows: The hole was to be bored and reamed and one end of the hub faced; the sides of the rim were to be faced, and an interior portion of the rim bored and finished on a very slight taper, as shown, for the friction or rubbing surface of the clutch; and, finally, the face of the pulley had to be crowned and finished.

In order to accomplish all these operations at one handling of the piece, all the tools had to be specially constructed for the purpose. They consisted of a chuck for holding the work while being machined, a combination boring and hub-facing tool, a turret fixture for boring and finishing the clutch portion, and a special compound slide rest, with cutting tools at the back and front.

Two views of the chuck are shown in Fig. 2, and the several parts of the chuck appear in detail in Figs. 3 to 7, inclusive. The chuck so holds the work that all points to be machined are easily accessible to the cutting tools. There are nineteen parts in the chuck. The body is a forging of mild steel, and is bored and threaded at the back to fit the spindle of the turret lathe. There are three projecting lugs or false jaws *I I*, as shown, and the faces of these were turned off to form three even supports for three of the pulley arms. The outside sur-

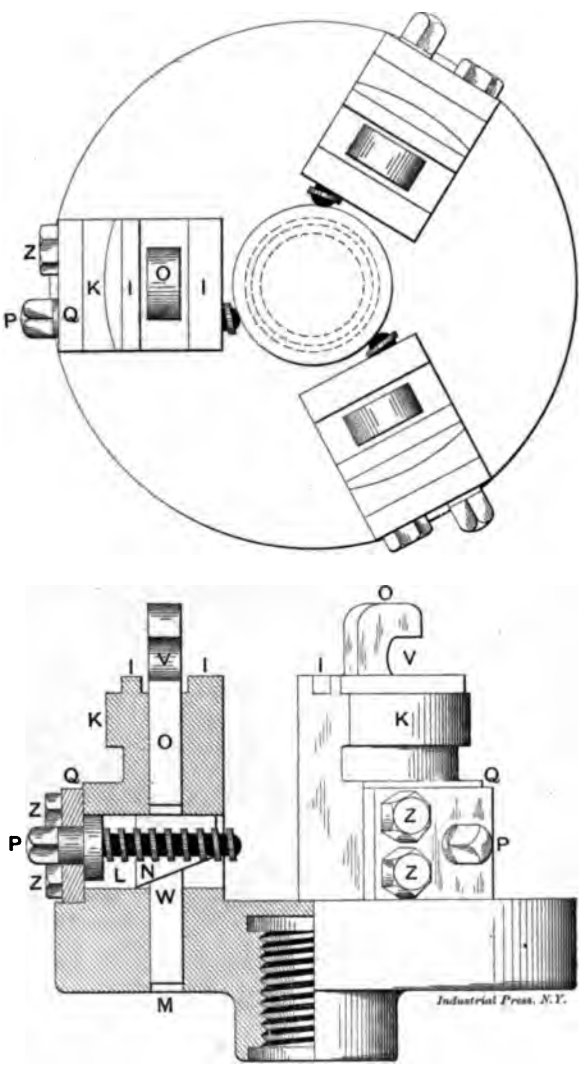
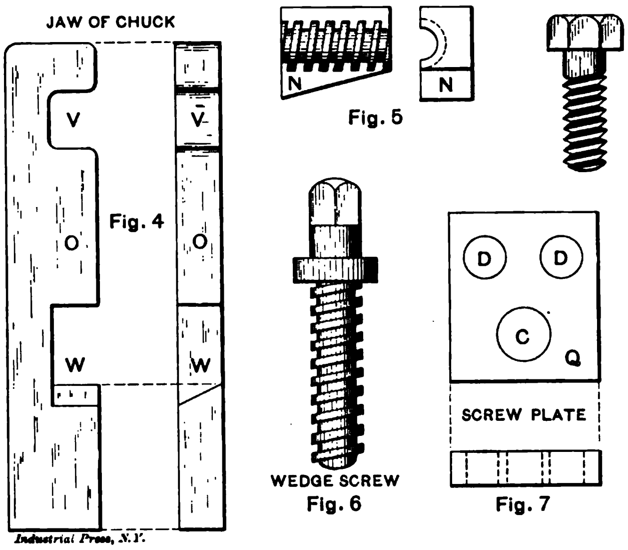


Fig. 2. Chuck for Use in Machining the Pulley, Fig. 1. It locates the Pulley in its Proper Position and Holds it so that all the Surfaces can be Finished at One Operation.

faces *K K* of the lugs were turned to a suitable diameter for the purpose of locating the pulley in a central position by means of the inside of the pulley rim which comes in contact with these surfaces *K K* when the pulley is held in the chuck. The surfaces *K* and *I* of each lug, therefore, determine the position of the pulley with sufficient accuracy for machining while the arms are clamped securely by the jaws *O O*.

The construction and operation of the chuck will be clearly understood from the engraving, and it will be seen that the pulleys can be clamped in position or removed very readily. The three jaws O O which grip the spokes of the pulley and

draw them against the faces of the false jaws, are moved in or out as required, by simply tightening or loosening the wedge screws *P*, which raise or lower the wedges *N*, as shown in the sectional view of Fig. 2. In making the chuck it is



Figs. 4 to 7. Details of Chuck.

interesting to note that the finishing of the rectangular holes *L* and *M*, Fig. 3, in which slide the wedges *N* and jaws *O*, was accomplished by the use of broaches of the type shown in Fig. 13. For such work the broach should be constructed with very coarse teeth on the lower end to take out the bulk of the sizer. The broaching of the holes is accomplished by forcing the broach completely through them under the power press. The machining of the other parts of the chuck presents no difficulties and will be understood by reference to the figures. All parts except the body of the chuck are of tool steel and all wearing surfaces were hardened and tempered.

The combination boring and hub-facing tool holder is shown in Fig. 12. After the hole in the pulley is bored and the hub faced by this tool, it is finished by the small chucking reamer and by a finishing reamer of the floating type, to insure the hole being true and round.

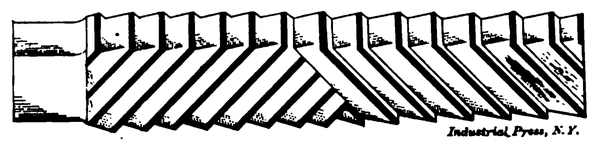


Fig. 13. Type of Broach used for Finishing the Holes for the Wedges and Jaws in the Chuck.

The special turret tool for finishing the clutch portion of the pulley is shown in Fig. 8, and details of the parts in Figs. 9, 10 and 11. The three cutting tools are held in dovetailed channels finished to an angle of three degrees with the center line of the fixture, this being the angle of the clutch surface on the interior of the pulley rim. Having the grooves finished at this angle makes it easier to set the cutters correctly and as the cutters are held by clamping, they can be adjusted to remove the right amount of metal.

In Fig. 14 is a plan view of the special compound slide rest, with the cutting tools in position. This slide rest consists

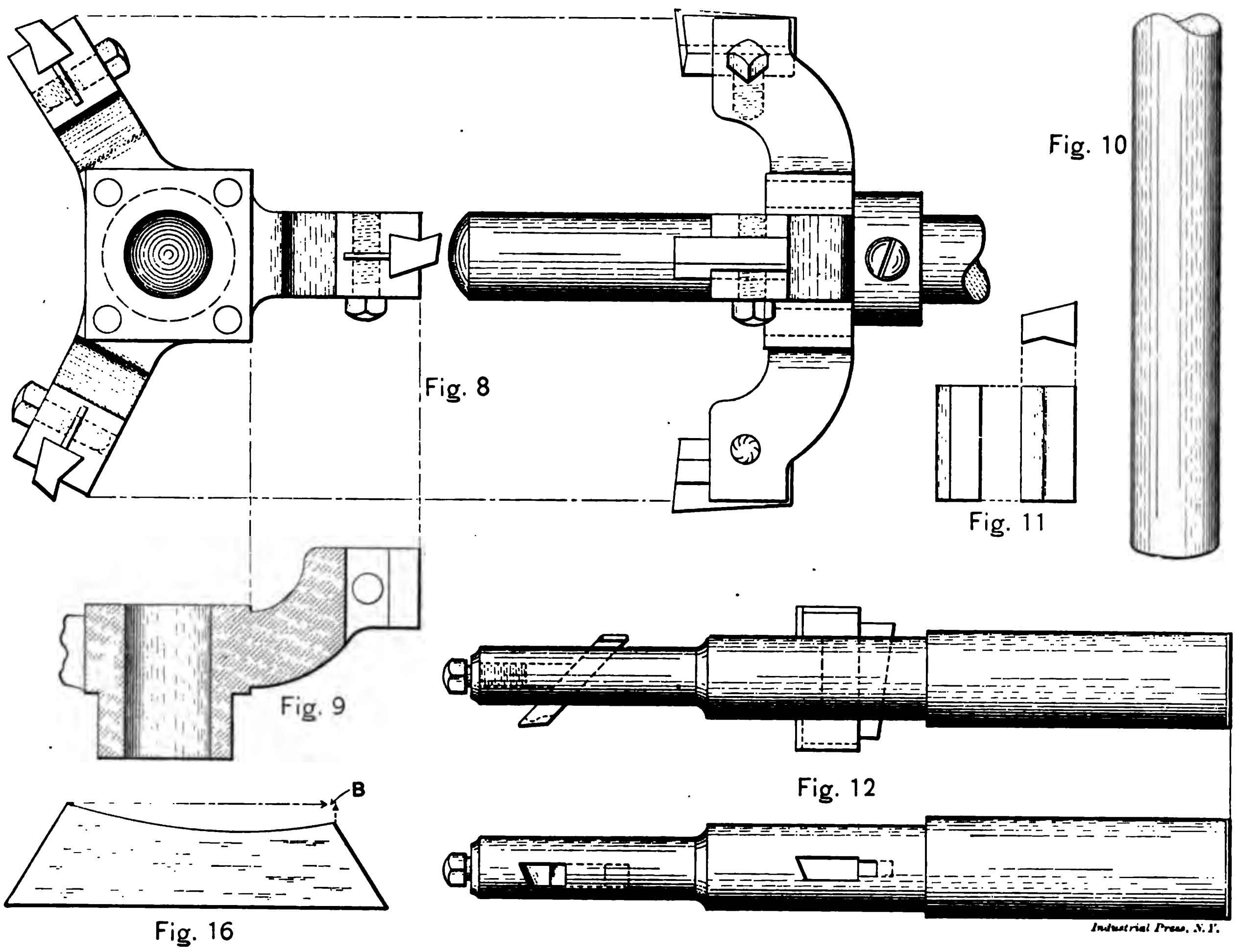


Fig. 8. Turret Tool Holder for Finishing Taper Surface on inside of Pulleys.
Fig. 9. Cross Section of Holder showing Method of Fastening the Cutting Tools.
Fig. 10. Leading Stud which Enters the Finished Hole in the Pulley and Braces it while the Taper Portion is being Finished.
Fig. 11. Cutting Tool.
Fig. 12. Combination Holder for Boring and Hub-facing Tools.
Fig. 16. Crowning Tool, showing Manner of Finishing the Formed Face.

stock. It will be noticed that the teeth on the two ends of the broach are so inclined as to give shearing cuts in opposite directions, the object of this being to break off the chips as the broach passes through the work. The upper end of the broach is left perfectly straight for about two inches and serves as a

of the main casting *A*, which is fitted to the carriage of the turret lathe, replacing the cross slide, of the compound rest *B* and *C* in which the gashing or roughing tools are held, and of the face crowning and finishing tool fastened within the main casting *A*, in a dovetailed groove at the back, as clearly

indicated in Fig. 14. There are seven roughing tools and two side tools, located in channels in the slide *C* and fastened by set-screws in the strap *D*—the six short ones for gashing the scale and roughing off the face, and the other two for facing the sides of the pulley rim. The face crowning and finishing tool is located in such a position in the body plate *A* that its gashing or roughing tools are next run in and fed sideways about 3-16 inch, thus removing all the scale and the sides of the pulley are faced by the side tools, all that is necessary being to clean them up.

To crown and finish the pulley the whole slide rest is fed out by the cross-feed screw of the carriage until the entire

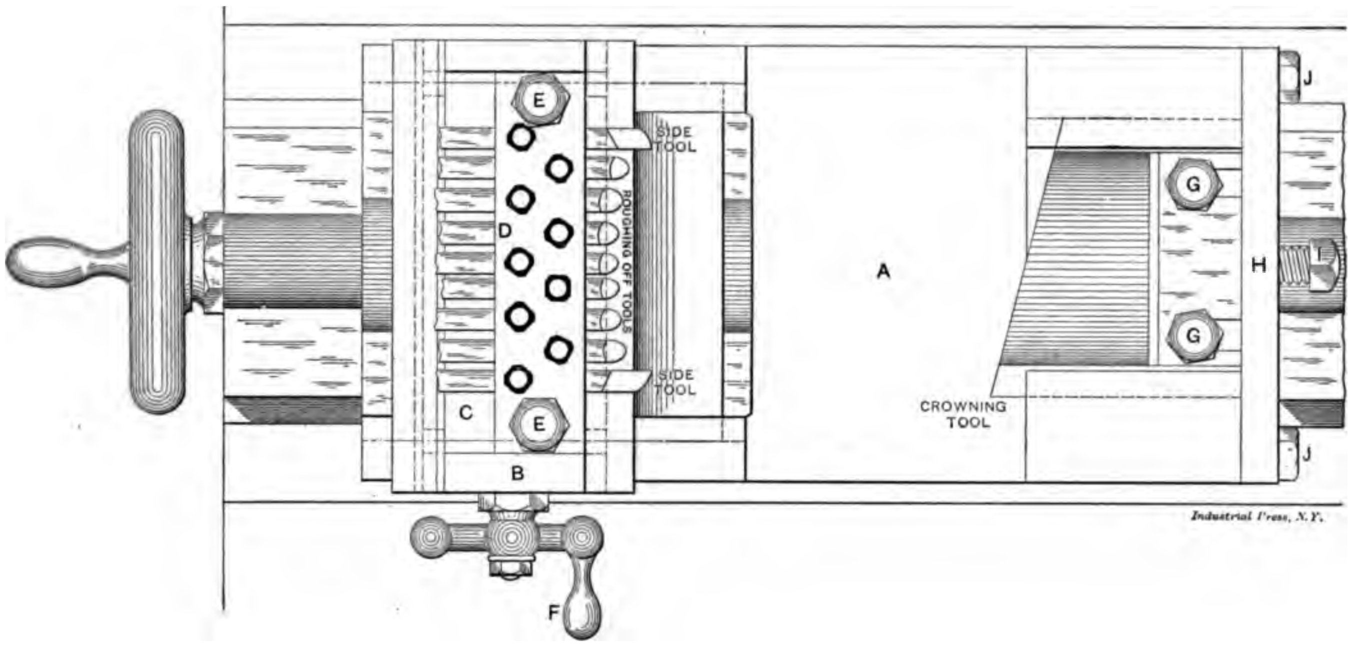


Fig. 14. Plan View of Special Compound Slide Rest complete, with Tools in Position for Roughing off the Scale, Finishing the Sides and Crowning the Face of the Pulley.

cutting edge will operate in a line tangent to the periphery of the pulley; and as the tool is designed to take a shearing cut, the metal is removed progressively from one side of the pulley to the other, thus reducing the strain and the tendency to chatter. A plan of the slide rest is given in Fig. 14, and in Fig. 15 is the elevation, which also shows the manner of holding the pulley in the chuck.

Referring to Fig. 15, it will be seen that the pulley is secured in the chuck by slipping the spokes into the notches cutting edge of the crowning and finishing tool has passed beneath it and finished and sized it to the shape and size required. The use of this set of tools insured the exact duplication of the work produced at a low cost.

There is one point that must not be lost sight of, when constructing a forming and finishing tool of the type shown here, for crowning the pulley. As the face or cutting edge is finished and ground so as to take a shearing cut, and the tool is located in such a position in the main casting as to give it

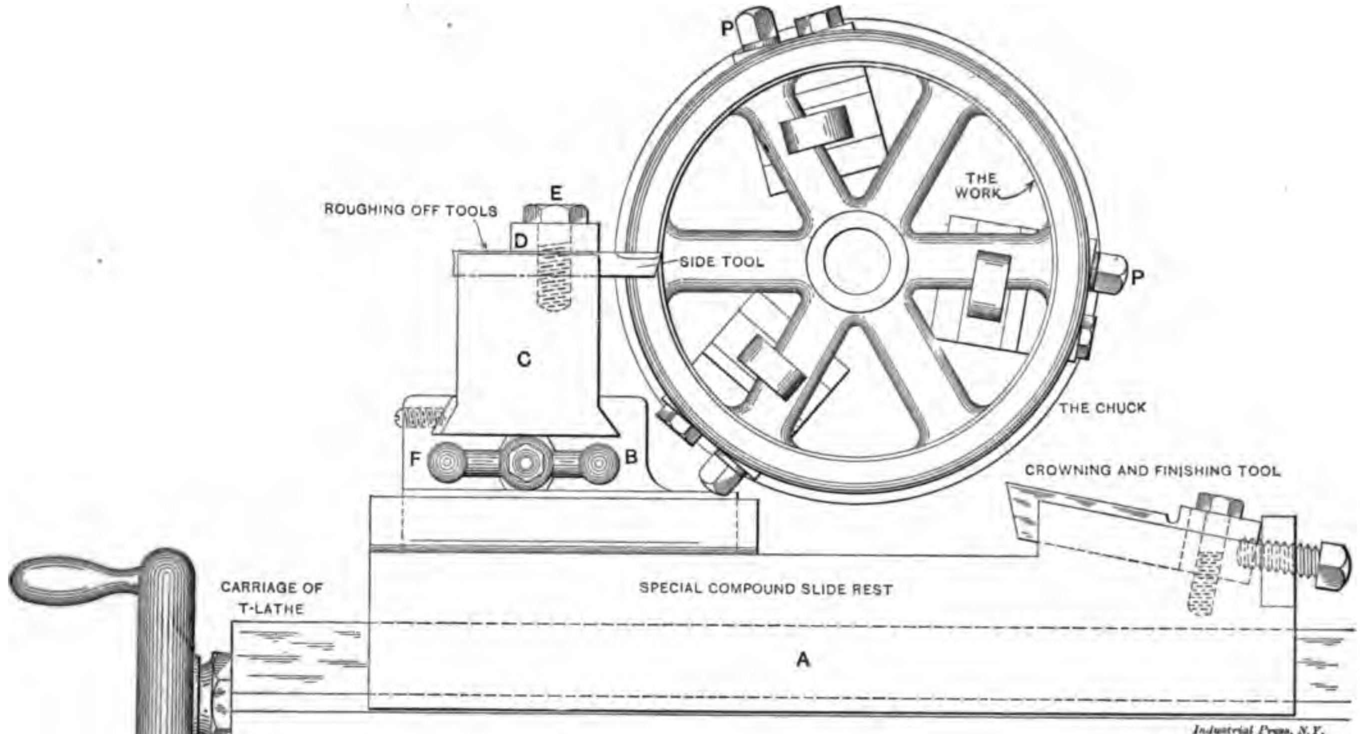


Fig. 15. Manner of Holding Pulley in the Chuck and use of the Special Compound Slide Rest for Finishing the Face and Slides.

of the jaws and tightening the wedge screws *P* so as to draw the spokes tightly against the locating faces, as shown. The hole in the pulley is then bored and the hub faced by the combination tool shown in Fig. 12, after which the clutch portion is finished by the fixture shown in Fig. 8, the leading stud supporting the work when it is being machined, and remains in the hole until the pulley has been finished. The face the required clearance angle, the forming face must be finished as shown at *B*, Fig. 16. As the tool is set at an angle with the face of the pulley, in order to produce the shape desired one side must be considerably higher than the other, as at *B*. This should be figured out and a template made, according to the degree of clearance given and the amount of shear to the cutting face.

NOVEL TRAVELING CRANE ARRANGEMENT

PART OF THE SIDE OF THE SHOP CAN BE MOVED TO ENABLE THE CRANE TO PASS OUTSIDE.

The main machine shop of Mackintosh, Hemphill & Co., Pittsburg, Pa., the well-known builders of heavy rolling mill engines and machinery, is L-shaped, one branch of the L being mostly given up to machine tools and the greater part of the other to the erecting floor. Each section of the L is served by heavy traveling cranes which make the handling of the heaviest castings within the shop a comparatively simple matter, but as the arrangement of the shop buildings and those on adjacent property is such that a railway switch could not be carried into the shop without considerable sacrifice, the problem of crane arrangement so as to admit of economical handling of parts for railway shipment was one that required considerable thought and designing before it was satisfactorily solved.

The solution is as simple as it is novel and is plainly shown in the three accompanying cuts, Figs. 1, 2 and 3. A narrow street separates Mackintosh, Hemphill & Co.'s shops from the adjacent buildings, and through it the railway switch is laid. The switch runs parallel to the branch of the L given

Fig. 1. Showing how the Crane Tracks extend through the Side of the Shop.

up to the erecting floor; consequently the crane tracks for the machine floor run at right angles to the railway switch. These tracks are carried over the switch as shown in Fig. 1 so that the crane can travel outside of the building and deposit its load directly on a flat car. But this makes necessary an opening of considerable size in the end of the shop which would be incompatible with keeping the interior at the proper temperature for comfortable working in winter. It was, therefore, necessary to provide the opening with a door which can be readily opened when the crane is moved out over the switch and immediately closed when the necessity for its being open is removed. The door closing the opening, which is shown closed in Fig. 1, is carried on trucks at the ends, the same as the crane, which travel on the same tracks. In Fig. 2 the door is shown moved over to the left and the opening unobstructed for the passage of the crane. Fig 3 shows the crane outside of the shop, with the hook directly over the box car which happened to be standing on the switch at the time the photographs were taken.

The manner of moving the door is simple, the crane being utilized for the purpose. When the door is to be opened the crane pushes it over to the position shown in Fig. 2, and when it is to be closed the crane engages it by means of two latches which draw the door after the crane to the opening and then are disengaged, leaving the opening closed. It will be observed that the opening in the end of the shop communicates by a narrow slit with that made by the sliding door beneath. The chains pass through the narrow opening and the load is carried through the lower door. The opening and closing of the crane runway is accomplished so easily that it is regarded as being of very little trouble, even in

Fig. 2 The Side of the Shop is on Wheels and can be Moved Out on the Crane Tracks.

winter, when it is quite necessary to close it at each trip of the crane to the outside of the shop when loading a car on the switch. The operations of opening and closing the door, being practically automatic, interfere but little with the crane operator's other duties.

The foundry is located beyond the machine shop and castings from it may be carried directly through the machine

Fig. 3. Showing how the Crane passes through the Opening in the Side of the Shop

shop for shipment or may be machined and then shipped without traversing the same route twice. If, as in the case of engines and rolling mills, it is necessary to transport the parts to the erecting floor for assembling, a transfer is made at right angles from one traveling crane to the other and then back again when the parts are ready for shipment The adaptation of an old plant to modern manufacturing methods

has thus been very well worked out without entailing excessive cost.

In connection with the foregoing description, it may be of interest to some readers to learn that the works of Mackintosh, Hemphill & Co. were formerly known as the Fort Pitt Cannon Foundry or the Fort Pitt Foundry, which in many ways is historically famous. The Fort Pitt Foundry was established about 1810 by Joseph McClurg at the corner of Fifth Avenue and Smithfield Street, the present site of the Post Office, and was subsequently removed (1831) to its present site on Twelfth Street and the bank of the Allegheny River.

The Fort Pitt Foundry made cannon for the Lake Erie fleet under Commodore Perry and for the defence of New Orleans during the war with Great Britain, 1812-1814. In those days the cannon were bored in primitive boring mills driven by horse power, old worn-out or blind horses being generally employed for the purpose. Three or four years after, the horses were superseded by a high-pressure steam engine built by Oliver Evans. It was at these works that Lieutenant Rodman, while employed to superintend the casting of a large number of eight-inch guns, invented the famous Rodman cannon, which owed its superiority to being cooled from the interior by a stream of water circulating through the core. The first Rodman cannon was cast in 1849, and subsequently many hundreds were made, which were used in the Civil War. The largest one made had a bore of twenty inches and weighed, when finished, about fifty-eight tons. The first locomotive built west of the Allegheny Mountains was constructed at these works in 1841.

• • •

NEW SHOPS OF THE C. R. OF N. J.

AN INTERESTING EXAMPLE OF CONCRETE CONSTRUCTION.

While the use of concrete in substitution for masonry is constantly becoming more prevalent, there has not come to our notice an example where its use is so extensive in the construction of industrial buildings as in the instance of the new car-shops which are now being built at Elizabethport, N .J., by the Central Railroad of New Jersey. With a single exception, all the buildings in this plant are being constructed with concrete walls. In the case of three buildings and a large fresh water reservoir, concrete is employed in building the roof as well as the walls and foundations. The machine shop has concrete foundations and brick walls. This is the only building of the group where the brick construction was adhered to.

Throughout the entire work a series of interesting experiments was instituted. One thing that is strikingly at variance with the ordinary practice in concrete construction, is the entire exclusion of trap rock in the mixture. In various portions of the work different mixtures are employed, but they are either of cinder, furnace slag, sand and cement, or gravel, sand and cement. For the foundation and heavy work the latter composition is employed. In some of the walls the cinder mixture is used. In every instance the mixture is approximately four to one. Work on the buildings has been in progress several months, and it is not expected that the buildings now under way will be completed prior to January 1, 1902.

Probably the most conspicuous portion of this undertaking is the large roundhouse, the walls of which are now approaching completion. This building is of the usual semi-circular construction. It is to be 400 feet in diameter. Half of the wall is now ready for the roof; the other half is about up to the windows. This building is being constructed entirely of concrete up to the roof. The roof will be of wood, with an upper surface of tar and gravel. The concrete wall is being built eight inches in thickness. Owing to the wide spaces between the windows the wall is considered sufficiently safe to stand without bracing, with the exception of the westerly section, which is to be permanently supported by means of timber bracings. In the construction of this building the foundations and wall up to the window line were first finished, being built in the ordinary manner by pouring the concrete into molds built of tongued and grooved pine boards. For the construction of that portion of the structure above the window sills special wooden frames were built. These were just the proper height to extend to roof line from the finished portion of the wall, and were of sufficient width to allow for the molding of three windows with each set of frames. The window spaces were cut out of each frame. The frames were properly supported so that two stood directly opposite each other, and they stood exactly eight inches apart. As the concrete was filled in between each pair of frames small strips were nailed along the sides of the window spaces, and thus the intervening spaces were filled in solid with the concrete mixture. The frames then remained for three or four days until the mixture hardened. Then they were removed and shifted to another portion of the wall, where the process was repeated. In this manner half a dozen sets of frames are being made to serve for the construction of the entire wall, with the exception of the west end, where a special frame with extra supports is erected.

The pits in the roundhouse are also being constructed of concrete. The cement is poured in wooden molds which rest on solid foundations of concrete. The foundations are about 12 inches thick, and rest on sheets of expanded metal, which are calculated to aid in obtaining a solid bottom. It may here be remarked that this kind is employed in connection with all foundations throughout the plant, as the grade at this point is about even with tide level and water is encountered a few feet below grade. Consequently throughout the entire work the foundations have necessarily been planned wide and flat rather than deep. In pouring the track beds long 1-inch bolts are imbedded vertically in the mixture at proper intervals, and to these the shoes holding the rails are fastened. Directly in front of the roundhouse there is a peculiar little structure which presents the appearance of a solid block of concrete 180 x 70 feet. It is of concrete—walls, roof and all. It will be used as a storage house for oils. One little sunken doorway surrounded by concrete wall is its only opening.

Looking east from the oil house the transfer table, 170 feet wide, runs in a northerly direction for 400 feet. As this is comprised entirely of a series of parallel foundations, it is constructed throughout of concrete. The pits are similar to those in the roundhouse and the same method of construction is employed.

East of the turntable the big machine, erection and boiler shop looms into view. This building is 700 feet long and 160 feet wide. As previously stated, the foundations are of concrete and the walls of brick. The structure is of steel skeleton construction. The foundation is built of a cinder-slag mixture and is 10 feet wide at the base, rising to a height of 6 feet above the grade and tapering to a width of 2 feet on top. Here commences the 12-inch brick wall. This is surmounted by a roof built of planking and tar and gravel. The foundations for the various machine tools to be installed in this building are also constructed of concrete. There is also a concrete subway running through the entire length of the building, which contains frequent manholes. In this the electric wires, pipes, etc., will be carried, and the manholes allow for entrance to any point, so as to permit inspection or adjustment of the wires at will. From this will be gathered, of course, that the machinery is to be operated electrically.

In back of the machine shop the forge shop is being erected. This building will be 175 x 300 feet and will be built of concrete around a steel frame to the front. The roof will be of planking, tar and gravel. The walls are 8 inches thick.

The power house is the only building in the entire group in which any attempt at ornamentation was made. Plain as it is, the favorable appearance of box column effect will be readily appreciated. This is another structure entirely of concrete. Floor, walls and roof are all of the concrete composition. The foundations for the boilers and the engine bed are also built of concrete. The building is 175 x 22 feet and attains a height of 25 feet. Alongside of the powerhouse there is a storage reservoir for retaining rain water drained from buildings.—*The Contractor and Real Estate Record.*

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A Chinese proverb truly says that he who labors with his strength shall be governed by others, but he who labors with his mind shall govern others.

NEW REMONTOIR CLOCK.

A CLOCK MECHANISM HAVING NEW FEATURES OF INTEREST TO THE DESIGNERS OF FINE MACHINERY.

Fig. 1. Exterior of Clock.

This design is by James Arthur, President of the Arthur Company Machine Works, 188 and 190 Front Street, New York, where seven of these clocks have been built, exclusively for presentation purposes, and where one may be seen running.

The complete clock is shown in Fig. 1. It stands nearly seven feet high and the top is finished with a Doric Stylobate to form a base for a piece of art work. Both the front doors are hinged, and as they are full width they give very free access, but in addition to this the head lifts off, leaving the movement standing clear all around. A mirror covers the whole back so that the movement may be seen from all sides. This, and the fact that the movement is skeleton work, makes it a fine example of exposed mechanism. The case is quartered oak, piano finished inside and outside. The design of the case is very severe and solid, its bold simple Grecian moldings making it very harmonious with the elaborate heavy movement. It would be difficult to imagine a piece of work in which flimsy ornament is so completely wanting and yet the effect of the whole is very striking.

The meaning of the term "Remontoir" may not be familiar to all. Strictly it means to remount, or to rewind. In this clock the main weight does not drive the seconds hand through the usual train of gears. Its office is to lift a frame once a minute, which serves as an auxiliary weight and which carries a wheel gearing directly with a pinion on the axle of the seconds hand. Once a minute, therefore, the clock is rewound by the lifting of this frame; and a much more uniform action is given the escapement than if the scape wheel were driven through a long train of gears in which the irregularities due to friction would affect the time-keeping qualities, particularly if the movement needed cleaning.

The following description of the works of the clock was furnished by Mr. Arthur:

Movement.

The general design is shown in elementary lines, Fig. 2. Wheels and pinions are shown by their pitch circles and number of teeth marked on each. The 12-hour, 1-hour and 1-minute axles are on the corners of an equilateral triangle of six-inch sides and are extended through the front frame, carrying the hands by friction; so they can be easily set, or taken off by the fingers. The clock has, therefore, no "cluster" or "face-plate wheels" as is usual in an ordinary movement.

Commencing with the great wheel *A*, revolving once in 12 hours, and calculating the train of gears connecting it with the hour hand at the right, we have,

$$\frac{144 \times 80}{40 \times 24} = 12,$$

which gives the 1-hour wheel *B*. Next, taking the train extending from the hour hand to the fly *L*, we have,

$$\frac{120 \times 120}{24 \times 10} = 60;$$

that is, the fly must make one turn per minute. The pinion *C* of this train is also used as an intermediate between gears *B* and *D*, thus making an hour wheel of *D*. The wheel *D* is mounted loose on a stud projecting inward from the back frame and is therefore only an intermediate, or stud wheel, as it has no axle. From this 1-hour wheel *D*, towards the escapement we get,

$$\frac{120 \times 120}{16 \times 15} = 60$$

revolutions per hour, giving the 1-minute wheel *E*, which is on the same spindle with the 15-tooth pinion at the upper apex of the triangle. Now, note that the revolutions of the fly *L* and the scape wheel *E* are equal, being one per minute. If we stopped here we would have only an ordinary clock train, much more elaborate than usual, but still only a running train. The meaning of these extra wheels will become plain as we proceed to the remontoir movement. Anyone interested can easily draw this movement actual size by laying down a 6-inch equilateral triangle and drawing all the gears 24 diametral pitch, making the scape wheel 4 inches, and the axle of the anchor and pallets 4 inches above scape wheel axle. Dials are 6 inches diameter and touch each other.

Remontoir.

Remember that wheel *D* rides on a stud in the back frame. Into this stud the end of the scape wheel axle is pivoted at its rear end. A similar stud is fastened in the front frame and through it passes the front end of the same axle, carrying the seconds hand. This leaves the scape wheel axle running in fixed bearings and free from disturbance. *F G* represents the sides of a complete rectangular frame swinging on the two studs above mentioned. These studs project inward and frame *F G* is of such a width that it just swings easily inside the clock frames. In this frame, wheel *H* and pinion 16 are mounted on the same axle and pivoted. Bracket *I* is part of this frame and against this bracket rests the wiper, or arm *J*, which is on the axle of the fly. This evidently stops the whole train of the clock from wheel *D* down to the great wheel *A*. But what would we expect to happen with the wheels *E H* and their pinions?

The end of the frame to the left is made heavier by wheel *H*, with its pinion, and pinion 16 ought to roll *down* on the

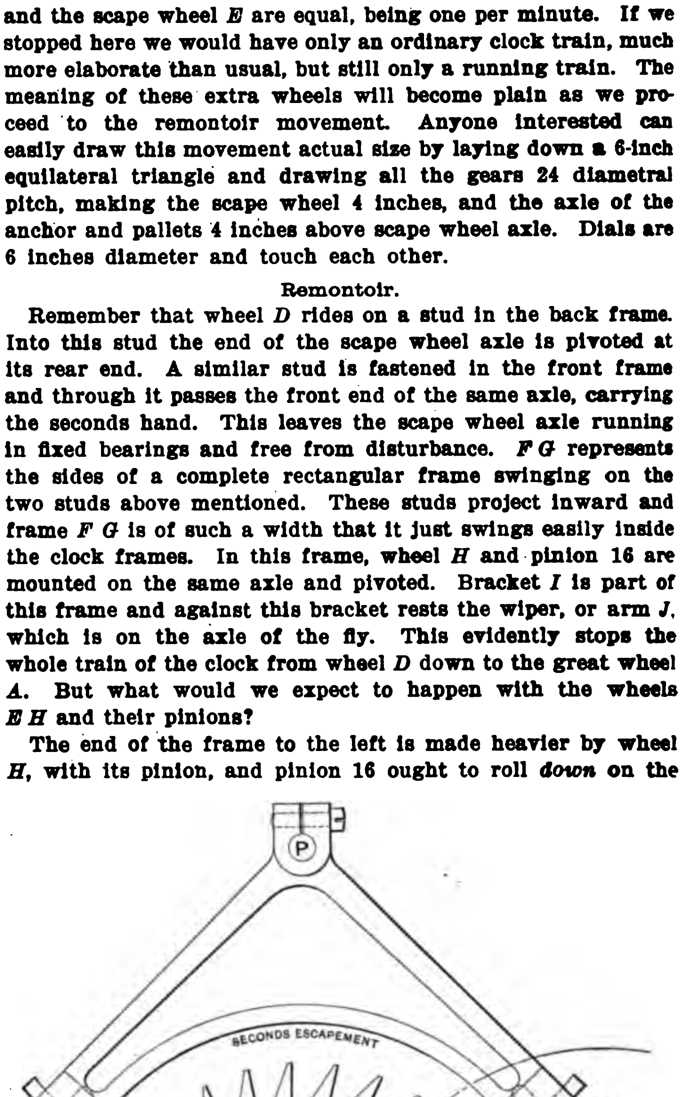


Fig. 2. Escapement.

wheel *D* (now standing still). That is, the end of the frame *F*, with wheel *H*, and pinion 16, will *sink downwards*, driving the scape wheel as per arrow for one minute, or one revolution. At the end of this minute the end *G* of the frame has *risen* till the wiper *J* passes the lower end of bracket *I*, and the fly makes one turn; which means that the train with

the hour and minute hands moves forward one minute. This motion lifts the end *F* and brings end *G* *down* again to the position shown in the drawing. The motion of 1 minute advances the wheel *D* one-sixtieth of a revolution, and by this motion wheel *H* and pinion 16 are lifted to roll *down* again for another minute. In a certain sense wheel *H* is always rolling *down*, even during the time it is being lifted; in other words *H* is continuously driving scape wheel *E*. A small balanced crank M, which is adjustable, will be seen on scape wheel axle. The tip of one wing of the fly *L* drops on this little crank pin about the 57th second of the minute and is liberated in the middle of the 60th second, letting off the remontoir movement so that the second and minute hands register at the same instant of time on the division marks of their respective dials.

of the clock, but is a refinement, and can be set to let off the remontoir movement even to the fraction of a second.

The working out of all details in this design can be traced in the general views, Figs. 5 and 6. Dials are graduated on a dividing engine, the figures only being engraved, and the finish is dull, or "frosted," silver. This accuracy of graduation taken along the high numbered train of finely-cut wheels gives an unusual precision in the registration of the hands on the dial marks.

The frame work is so constructed that all the delicate parts of the movement, pallets with their axle and crutch, remontoir frame, wheel *H* and axle, wheel *D*, scape wheel, and fly can all be taken out without taking it apart. This leaves only the large heavy parts of the movement pivoted directly in the

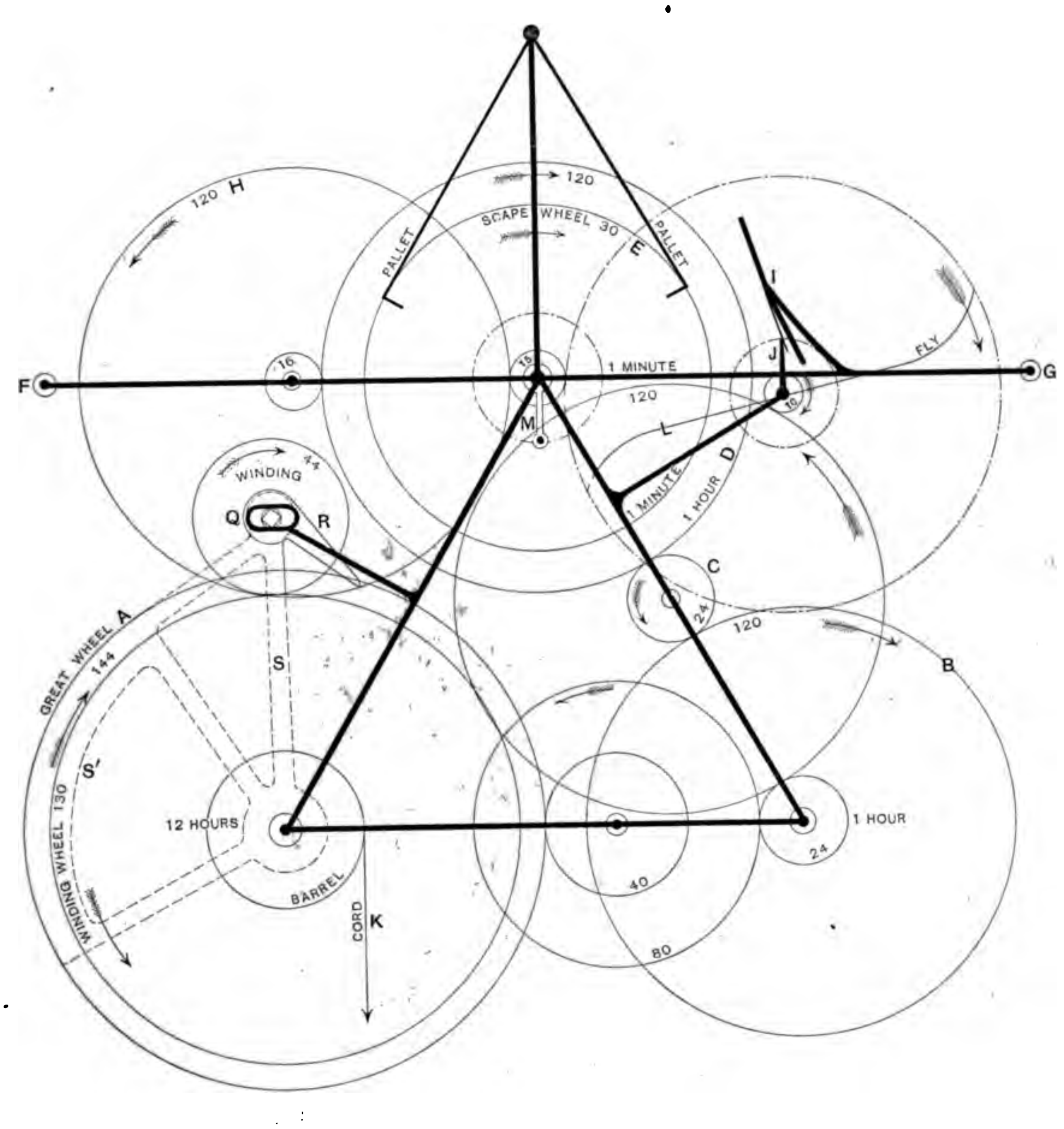


Fig. 3. Diagram of Movement.

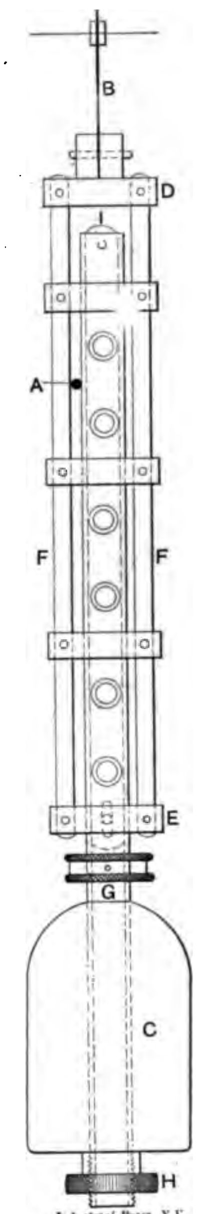


Fig. 4. Compensating Pendulum.

In the elementary explanation of letting off the remontoir, this crank was left out for the sake of simplicity. To make the matter positively plain let us suppose that in Fig. 3 the remontoir has just been let off, the wiper *J* striking the spring on *I*, which acts as a cushion to quench the blow. This blow is quite light, as the office of the fly is to produce an easy, uniform motion. Still further, this moderate motion enables us to see the one minute advances of the hands; for without the fly the motion would be too quick and jerky. As the end *G* of the frame rises, *J* passes the spring and rests on the lower end of bracket *I*, which it passes about the 57th second, at which point in the motion the tip *L* of the fly is held by crank pin of *M* till liberated in the middle of the 60th second. This crank *M* is not necessary to the correct running

frame. This is no small matter, for all parts requiring delicate adjustment can be attended to without even taking the main frame from the clock case.

Escapement.

In Fig. 2 (arms of wheel not drawn) the escapement is shown so that little explanation is necessary. It is the "Graham" or dead-beat type, the pallets *O O* being portions of a circle around center *P*. These pallets are clamped in grooves, two screws in each, so they slide under the clamps for setting. These and the clamp hub at *P* enable all adjustments to be made without beat screws in the crutch. The crutch is simply a steel wire bent at the lower end to go between the bars of the pendulum at *A*, Fig. 4, and is somewhat elastic, so as to avoid injury to scape wheel if pendulum

is swung too far at any time in starting the clock. The "dead" surfaces O O are always correct and cannot be changed by the other adjustments. Further, these inserted pallets have another advantage, as they can be made flint-hard and polished to any degree of accuracy and fineness as separate pieces.

Pendulum.

In Fig. 4 (shortened in drawing) *B* is the usual spring, in this case ½ inch wide and 9-1000 inch thick. The cross-heads *D* and *E* are riveted fast to side rods *F F*, which are about 32 inches long. The three cross-heads in center may

Fig. 5. Front View of Movement.

be neglected as they are simply guides to keep the rods parallel. The bob *C* is 8 inches long and slides on the steel tube *G*, and is adjusted by a fine thread nut *H*. The milled collar at *G* is pinned fast to the steel tube, and by holding it by one hand very fine adjustment of nut *H* may be made with the other. Inside the tube is an aluminum rod *I* reaching just below the cross-head *E*. Tube and rod are pinned fast at *I*, but the aluminum rod *only* is pinned fast to cross-head *E*. The tube is slotted where the pin of cross-head *E* passes through it, as shown in dotted lines. Now, note the result of this. The cross-head *E* is *suspended* from *D* by rods *F F*, and from this same cross-head *E* is *projected upwards* an aluminum rod to *I*, just like a column. It acts as a column, for the bob is suspended from its top end *I* by the steel tube *G*, which passes freely through cross-head *E*.

As aluminum expands by heat more than twice as much as soft steel this column will expand more than enough *upwards* to compensate the expansion *downwards* for the tube and side rods together. This excess is needed to correct the spring *B*, and also a little at the lower end of the pendulum, since the brass bob *upwards* is not quite enough to compensate the portion of the steel tube between *G* and *H* *downwards*, because brass has *less* than half the rate of steel.

The result of this is that the center of oscillation will be approximately free from change; or, in other words, that the pendulum will be constant in length so that its oscillation will be uniform and the clock will not be appreciably influenced by temperature. While *expansion* of metals only has been spoken of above, it is evident that *contraction* by sinking temperatures will act on the pendulum in the reverse order without changing its length. The six holes shown in the tube are to give circulation of air and cause all parts of the pendulum to expand and contract at the same time. It might be well to state here that this compensation for temperatures cannot be made perfect. The mercurial pendulum is of the same class; that is, it depends for compensation on the different ratios of expansion in metals, but since aluminum, with its high ratio, has become an article of commerce, a pendulum equally accurate, and much less subject to accident, can be made as above.

Finally, as the principal parts of this pendulum are about the same thickness it will respond to quick changes in a nearly uniform manner. The fact that the bob *C* would heat up or cool off rather *behind* the other parts is hardly worthy of notice, since the amount to be corrected here is so small as to be almost a vanishing quantity.

It is well known that a seconds pendulum is a little over 39 inches between points of oscillation and suspension; and if a silk thread is used to suspend a small lead pistol bullet this will be found correct for a short experiment. But the pendulum above described is over 43 inches from point of suspension to center of bob *G*. How is this? Because this is necessarily a compound pendulum on account of the weight of rods, tube and cross-heads which are nearer the point of suspension than the bob *C*. As all this matter tries to beat *quicker* than seconds the bob must be lowered 4 inches to correct them. In other words, at this length (43 inches) the bob tries hard to beat *slower* than seconds and thus counteracts the rods higher up; so that after all, the points of oscillation and suspension are at the correct theoretical distance, the former in this case being very near the top end of the bob at *G*.

Winding.

A good timekeeper must run correctly while it is being wound. In this case the great wheel *A*, Fig. 3, is *fast* on the 12-hour axle, while the winding wheel 130, the barrel and the

Fig. 6. Rear View of Movement.

ratchet wheel are one piece and ride free on the axle. The pawl is on the great wheel. The winding pinion 44 is fast on an axle passing out in a square end to the front, as shown. It will be seen that this axle passes through the front frame in a slot at *Q*, giving it a motion equal to over two teeth of the great wheel. From this winding axle a pawl *R* lies in the teeth of the great wheel. A link *S* connects the 12-hour axle

to the winding axle, and this link has a sector, or heavy side S', tending to keep the axle to the left towards Q. When the clock is running this pair of winding wheels (130-44) are simply idlers. Now, put on the key and turn *right hand*, and the pawl R will push the great wheel *forward* with about the same force it was receiving from the weight and the clock is not disturbed. In other words, owing to the slot Q in the frame the pawl R must be made the fulcrum against which the winding axle presses with enough force to lift the weight. Arrows on the winding wheels show the direction *while winding*. Of course, while running with the clock they go the opposite way. Winding is supposed to be weekly, but the clock will run 8½ days, so it may be forgotten for a day.

Gearing.

Those interested, even as amateurs, are aware that clock gears differ essentially from machine gearing in the fact that the drivers act only by their faces, and that these faces act only on the radial flanks of the pinions. Driving is, therefore, all done after passing the line of centers of any pair of gears. This clock, however, is cut with regular involute cutters on a plan tested by the designer for the last five years in a large clock which has run that time, without even being cleaned. A description of that clock can be found in MACHINERY for January, 1900.

In a clock train the wheels are always the drivers and the pinions are the followers. The method of cutting the teeth is as follows: Size the wheels in the usual manner, but cut the teeth 10 per cent deeper, which will give a tooth noticeably thin. Size the pinions one-quarter diametral pitch small; that is, add only 1¾ pitch to pitch circle, and cut them regular depth. Mesh these gears seven-eighths the usual depth. Result—as teeth in both cases will be a little thin and meshing shallow the gears will work very loose, or have considerable "back-lash." Further, the pinions or followers are really a little less in pitch than their drivers, which gives action principally after passing line of centers. The looseness is necessary in clock gears to prevent dust or dirt from stopping the clock. Gears such as are used in machines would not answer in clocks for this reason. It is hardly correct to speak of back-lash in this connection, for it does not appear in clock work, as the wheels always drive slowly *one way*. This method of cutting, if not as good as the conventional "clock tooth," is certainly successful and gives results which seem beyond question. A good feature of the method is that it gives the correct center distances for any pair of wheels just as in machine work. This can be easily illustrated. Take a pair of wheels cut and mounted as in a machine. Remove them and cut the driver 10 per cent deeper; top off the follower, or pinion, one-quarter diametral pitch (= one-eighth all around) and re-cut to normal depth. Put them back in running position again and you have a pair of wheels on the correct center distance as described above. It therefore follows that center distances are correct in Fig. 3.

An interesting point in center distances may be pointed out in the case of wheel H, and its pinion 15. This distance is the *normal* for wheel D and its pinion 16, which is too wide for H, 15, apparently. This is overcome by making a calculation in proportion for H 15. This enlarges them such a small fraction that the 24 pitch cutters are still correct, especially as we are cutting a very loose fit. Pinion C being both a driver and a follower is sized normally and cut 10 per cent deep. Lower wheels of train have ¼-inch faces, diminishing upwards to ⅛ inch in H and E. All pinions are of tool steel and ⅛ inch wider than the wheels driving them. Frame work and wheels are of fine gun-metal and finished all over even to the arms of the wheels, as everything is exposed.

* * *

TWO MILES A MINUTE.

Experiments are being undertaken by the Society for Research, Germany, in the operation of electric cars at speeds of over two miles a minute. The experiments are attracting wide-spread attention, both because of the high standing of the scientists engaged upon the problem and the natural popular interest in improvements in transportation facilities. If an electric-motor car, taking its current from overhead wires and running upon an ordinary standard-gage track can carry passengers with safety at a speed of from 80 to 150 miles an hour, it is evident that the next few years will witness great changes in the means of travel between large cities.

Such enormous speeds involve questions of air resistances, weight, form and balance of vehicle, electrical transmission at high voltage and conversion to lower potential at some point between the generator and motor, and many other problems that would not occur to one unless he had investigated the subject. There were no reliable data, for example, to guide the designers in providing for the air resistance at such high speeds, and extensive experiments were conducted with large rotating fans to secure information upon this point.

The scene of the experiments with the high-speed trains is a stretch about 14¼ miles long from Marienfelde to Zossen, on the military railway line which runs southward from Berlin to the place last named. The following description of the experiments and the equipment of the road is taken from a recent report by U. S. Consul Frank H. Mason, of Berlin:

The line is of standard gage, single tracked, level, and nearly straight, there being but one slight curve—1,100 yards radius—near the southern extremity. The rails are of steel, weigh about 65 pounds to the yard, and are laid on wooden ties. During the past summer the track has been carefully surfaced, defective joints remedied and ties and ballasting put into perfect condition. Along this line have been set, at intervals of 100 feet, poles 20 feet in height, at the top of which is set in a vertical position and fastened by bolts a bow or arch of angle iron 10 feet in length, the chord of which supports the three brackets for insulators from which the three lines of conductors are hung. The conductors are ordinary copper wires about three-eighths of an inch in thickness, so hung that the trolley can make full contact from beneath.

These will carry a three-phase alternating current of 10,000 to 12,000 volts, to be generated at the works of the General Electric Company on the River Spree, about 5 miles northeast from Marienfelde, between which two points a special overhead line for transmission has been provided. One of the conditions of the problem is that this high voltage, so essential for effective transmission, shall be reduced to a safe and practicable pressure by transformers carried in the motor car itself. The measure of speed to be attempted is 124 to 136 miles, approximately, per hour, and the electrical apparatus must be sufficiently strong and heavy so that a run of 155 miles can be made at extreme speed without danger of overheating.

For this purpose two third-class passenger cars of the standard type used on the Prussian State railways have been built and turned over to Siemens & Halske and the General Electric Company of Berlin, respectively, each of whom have furnished the electrical equipments of one car according to their own ideas. There will be, therefore, two competitive machines, each representing the highest scientific skill of two leading electrical manufacturers of Germany.

The cars are about 72.18 feet in length and weigh 90.5 metric tons, of which 48 tons comprise the body and running gear (viz, two six-wheeled spindle trucks of the American type) and 42.5 tons are made up by the motors, transformers, and other details of the electric equipment. Each car is designed to accommodate fifty passengers, who, with the driver and conductor, will add about 4 tons to the aggregate weight of the carriage. The motors are four in number, aggregating 1,000 horse power, and are attached to the front and rear axles of each truck, the middle pair of wheels in each group of three running free. In the car equipped by Siemens & Halske the motors weigh 9,000 pounds, the transformers—which weigh 12 tons—are hung centrally beneath the floor, and a storage battery of 600 pounds weight supplies current for lighting purposes. The ends of the car are pointed to minimize wind resistance, and it runs, of course, in either direction. The wheels are 49 inches in diameter, and air brakes of the Westinghouse type are used. It is expected that the current will be reduced by the transformers carried under the floor of the car from the initial voltage of 10,000 or 11,000 to a potential ranging from 1,150 to 1,800 volts, which it is assumed will be sufficient to attain the proposed speed without danger to machinery or operatives.

WORKING DRAWINGS.—2.

HINTS UPON READING AND MAKING WORKING DRAWINGS-THE CONVENTIONALITIES USED.

When a draftsman has to make a drawing of a machine already constructed he first measures and sketches each part separately, putting all necessary dimensions upon the sketches and then he assembles these parts, so to speak, in the form of a general drawing. On the other hand, if he has to design a machine he will first make a general drawing with the parts in place and from this he will obtain the dimensions of the various pieces which he will draw separately, or at least in sufficient detail to show clearly what is wanted. In either case he must have both a general or an assembled drawing of the machine, and detail drawings of the machine parts, the order in which they are made depending upon whether he is working from the machine itself or is originating the design.

In the general views outlines are drawn of such details as are thought essential to clearness; but as certain features of construction and many of the small parts of the mechanism would inevitably be invisible to one looking at the assembled machine, they must be represented by dotted lines if they are to be incorporated in the general view. A multiplicity of these lines leads to confusion, however, particularly if it is attempted to dimension them, and for this reason the detail sheets are necessary.

We thus see that obscure details, not visible when looking at the assembled piece, may be represented either by the use of dotted lines or by making separate views of each piece apart from its relation to the others.

Sectional Views.

A third method of representing details is by means of sectional views. Suppose, for example, a drawing were to be made of a connecting-rod end, in which were the brasses, the adjusting wedge and screws, etc. A general view of the rod might be made, with part or all of the details shown by dotted lines; and then, on another sheet, or on another part of the same sheet, the details could be drawn separately and properly dimensioned. That would be one way to make the drawings. Another way would be to make a general view of the rod as before, but to show the end as though it had been cut or sliced in a plane parallel with the paper, and the upper

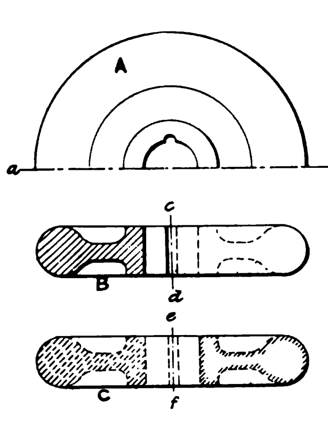


Fig. 12.

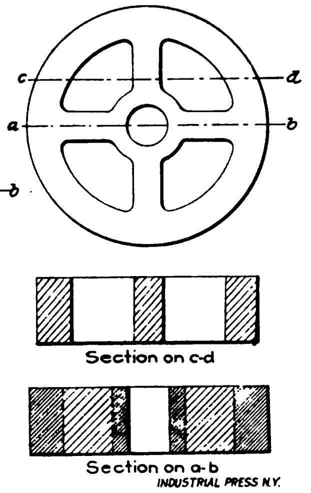


Fig. 13.

Method of showing Sections.

parts removed, exposing the details. The parts cut through would be "cross-hatched," bringing them into bold contrast, and the dimensions could all be placed on this one drawing. Such a method is possible with a simple construction having but few parts and is often adopted to advantage.

Sectional views may also be used for much simpler purposes than above outlined. They may be used to show the shape of the arm of a pulley or of any part of any casting that can be conveniently represented in this way. The cutting plane may be assumed to lie at any angle necessary to bring out the details most clearly; or, if desired, a sectional view may represent a casting as though it were cut through a part of the distance on one plane, and the rest of the way on another plane, either higher or lower, as convenient. All that is necessary to have the view clearly understood is to draw a line through one of the views of the piece, indicating just where the sectional view is supposed to be taken, and then to make a note on the drawing to that effect.

In Fig. 12 at *A* is a plan view of a hand wheel. As the wheel is symmetrical it is quite unnecessary to draw more than half the wheel, although the whole wheel may be drawn if desired. It is here represented as though cut in two along its diameter on the line *a b*. This line should be a dash-and-dot line, as shown, and not a solid line. It was pointed out in the last number that one of the uses of a dash-and-dot line is as a center line where a piece is symmetrical, and its use here would indicate that the half of the wheel not drawn was like the part that was drawn, even if it were not otherwise apparent; for under no other condition would the figure be symmetrical.

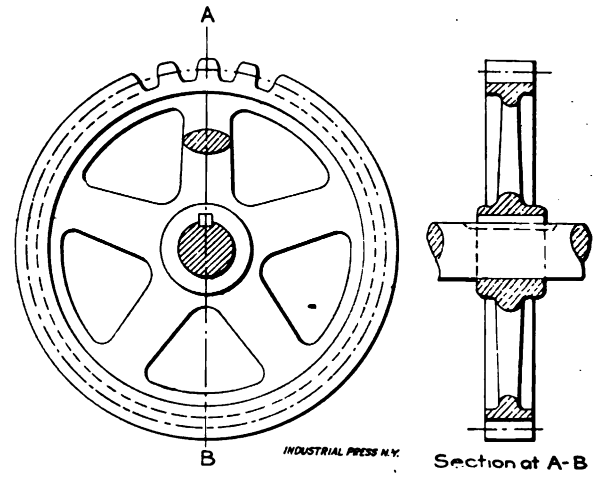


Fig. 14. Conventional Section of Gear Wheels.

At *B* and *C* in Fig. 12 are shown sectional and edge views of the hand wheel and the different ways in which they may be represented, according to the fancy of the draftsman. In *B*, to the right of the center line *c d*, is an edge view of the wheel in which the shapes of the rim and hub are shown by dotted lines, since they would not be visible to an observer who held the wheel so that he looked directly at the edge or rim. To the left of *c d* is a sectional view taken along the line *a b* in *A*.

In the view below this at *C* are shown two methods of drawing what are termed "dotted sections." The sections are supposed to be taken on the line *a b* as before, but cross-sectioning is done by dotted lines, indicating that the shape of the section would be as shown but that the parts in front of it have not actually been cut away. This is a very convenient convention to adopt at times. For example, in showing a milling-machine knee and saddle it would enable one to represent the knee and saddle as they actually appeared, and also to show a sectional view of the mechanism under the saddle and inside the knee. If, on the other hand, the view were drawn as though the knee were actually cut through one would not form an idea of its exterior appearance unless another view were drawn. It will be noted in the figure that the dotted lines extend clear across the section, as drawn at the left of *e f* and only along the edge of the section at the right of *e f*.

In Fig. 13 is a pump valve-seat having four webs connecting the outer rim with the hub. There are two ways of showing a sectional view of a piece in which webs occur. If the view were taken along the center line *a b* and sectioned, as usual, nothing would be gained, since it would give no idea of the shape of the webs. Some, therefore, prefer to take the section to one side of the web, as on the line *c d*, and as shown in the upper sectional view. This indicates clearly what the shape of the web is. Others, however, prefer to adopt the expedient illustrated in the lower sectional view. Here the section is supposed to be taken along the line *a b*, but where the plane cuts through the webs the sectioning or hatching is done with the lines further apart than in the balance of the plane, thus making enough distinction to show what part of the plane passes through the webs and what part does not. Both methods have their uses under suitable conditions.

In Fig. 14 are views of a gear wheel. The one at the left side is a side view and as all the teeth are of course alike it is unnecessary to draw more than a few of them. The pitch line of the teeth is represented by a dash-and-dot line, this convention always being followed. In the part of the rim where the teeth are not drawn, the face of the gear is indicated by a solid line and the position of the roots of the teeth by a dotted line. Others may prefer to adopt some other convention. To show the shape to which the arms are to be formed, a sectional view of one of the arms is drawn in this view. The end of the shaft is supposed to be broken off and is sectioned.

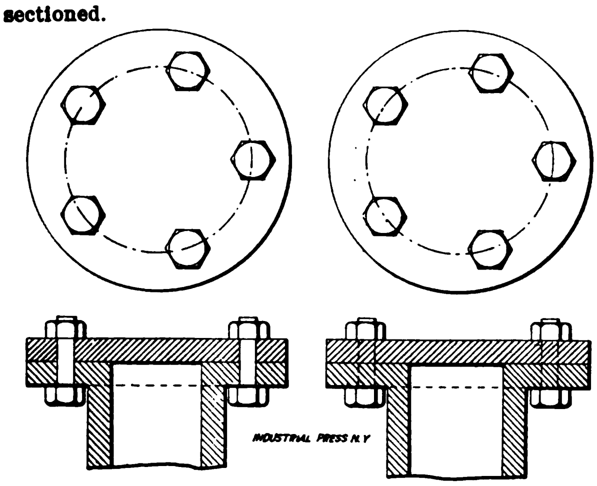
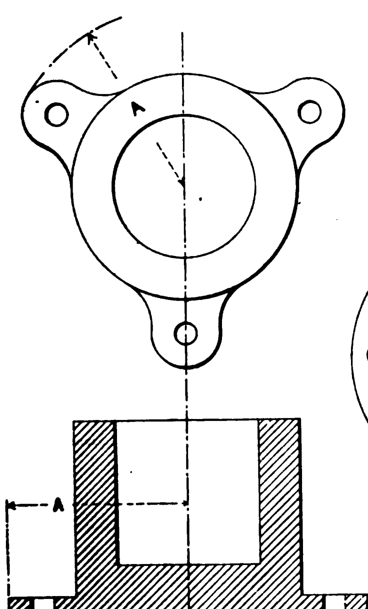


Fig. 15. The Representation of Bolts in Sections.

The right-hand view in Fig. 14 is a sectional view taken along the line *A B*. It will be noted that the shaft and key are not sectioned. The method followed in such cases is usually to section the castings or enclosing parts, such, for example, as the hubs, rims, etc., of a wheel, but not enclosed parts like shafts, rods, bolts, keys, etc. A bushing being both an enclosed and enclosing part might or might not be sectioned, individual judgment dictating the method here as elsewhere. This gear has five arms and the line *A B* cuts through one of them only. They are not sectioned in the right-hand view and two opposite arms are drawn as though both of them lay in the plane of the paper. While this is not correct,



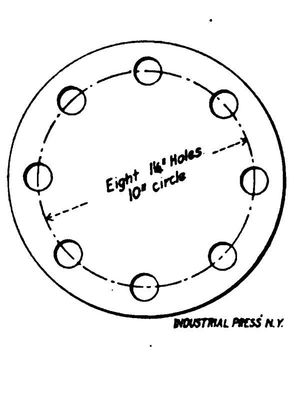


Fig. 16. Section of Unsymmetrical Object.

Fig. 17. Dimensions of Holes in a Circle.

it is the method usually followed. The method of representing the gear teeth in sectional views is generally as shown in this sketch.

In Fig. 15 are sectional and top views of a cylinder or pipe on which a blank flange is bolted. There are five bolts and the plane in which the sections are taken would cut through only one of them. Most draftsmen, however, would draw the sectional view, as indicated at the left. Two bolts are shown, as though both were in the plane of the section, and these bolts are not sectioned, but are drawn in full, as explained above. It is not necessary, moreover, to show more than two of the bolts, since it would detract from the clearness, and the top view shows plainly how many bolts there are. Some draftsmen think bolts drawn in this way are too prominent and prefer to represent them in sectional views, as shown at the right in Fig. 15. This method also has the sanction of good usage.

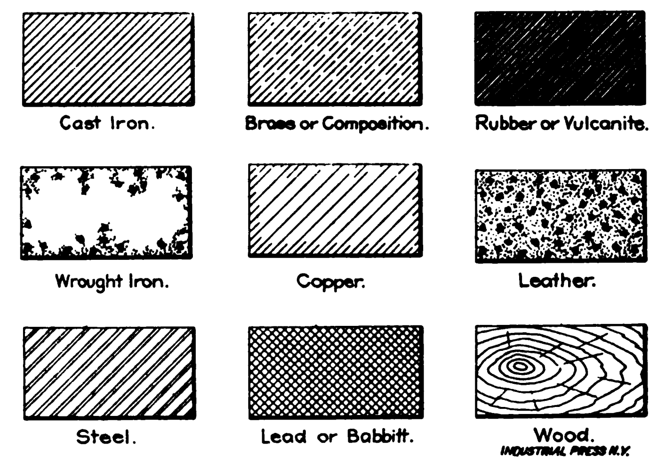


Fig. 18. Standard Methods of Cross-hatching.

Fig. 16 is another example of a figure that is not symmetrical in all respects. It shows two views of a step bearing having three ears or lugs for bolting it to its base plate. In making a sectional view of such a piece should the cutting plane be supposed to pass through the lugs? In most cases, yes, and according to common practice the sectional view would be made symmetrical, and the distance *A* in the lower view, from the center of the piece to the outer end of each lug would be made equal to the distance *A* in the upper view.

In any machine various kinds of metal and other material are used, and when sectional views are made it is convenient to have some standard method of cross-hatching the different parts to indicate what the metal or material is. Conventional sectionings adopted for this purpose are given in Fig. 18, the system there represented following very closely that used by the U. S. Navy Department. It should be said, however, that draftsmen are coming more and more to section all parts alike, adopting the style used for cast iron for all kinds of

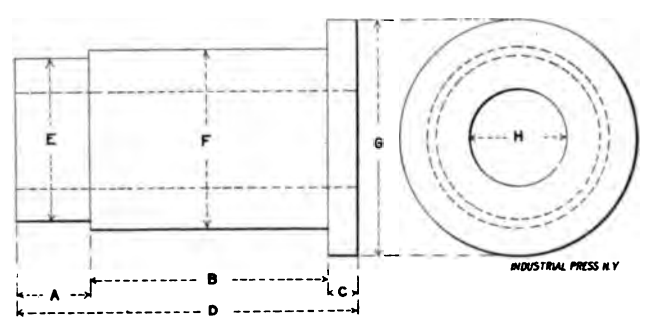


Fig. 19. Showing Location of Dimensions.

material and then to print on the pieces themselves what the material is of which they are composed. This avoids the possibility of mistake through failure to understand what the conventional methods of sectioning are supposed to represent.

Dimensions.

The most important part of a drawing is the dimensions. They should be given so fully and completely that a workman will never have occasion to measure a drawing. The dimensions should include an "over all" measurement and the different measurements that make up the "over all" size. Dimension lines and the extension lines which the arrow heads of the dimension lines touch are usually fine black lines made up of long dashes. They should be so drawn as to appear secondary in importance to the drawing itself. Some draftsmen draw all these lines in red ink and use a solid instead of a broken line. In a blue print the red lines will appear lighter than the black ones, making a good distinction.

In Fig. 19 is a sketch of a bushing. The diameter of the

bore is given at *H* by a dimension line passing through the center of the circle. It is somewhat confusing, however, to have more than one dimension line passing through a center and so it is better to have the other diameters given elsewhere, if possible, as at *E*, *F* and *G*. The length of the various steps of the bushing are given at *A*, *B* and *C*, and it will be noticed that they are slightly offset—that is, the dimension lines do not extend in one straight line. This makes a very clear arrangement. The over-all dimension is at *D*. Methods of placing dimensions on holes that are drilled in a circle or in a row are shown in Figs. 17 and 20. That in Fig. 17 requires no explanation. In Fig. 20 center lines are drawn in each direction through the centers of the holes and the dimensions are given from center to center each way, and also from the edges by which the holes are to be located.

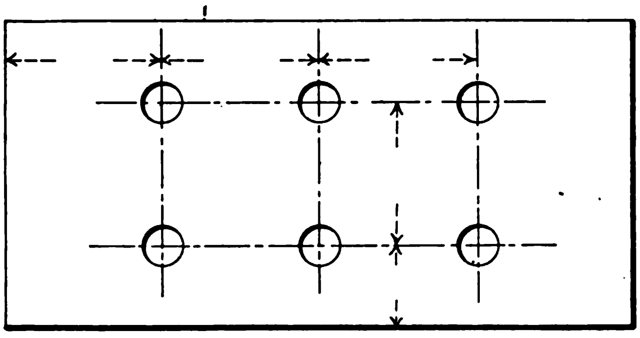


Fig. 20. Dimensions of Holes in Straight Lines.

Fig. 21 refers mainly to the dimensions of bolts. At *A* is a Hex. bolt, so drawn that three sides of the head are visible. Bolts are usually drawn in this way because they look well, and as most bolts used in machinery are standard and taken from stock no dimensions are necessary other than to specify the diameters and lengths. These may be printed on the drawing, or better yet on a list of bolts and other small parts, sometimes called an order list, which should accompany the drawings. Every bolt and machine screw should be specified in some such way. At *B* is a Hex. bolt, so drawn that only two sides are visible. If it is a special bolt it should be represented like this so that the dimension across flats can be given, to which the head is to be milled. At *C* and *D* are two ways of drawing a square bolt, according to whether the dimension across flats is necessary or not. In cases like *B* and *D* the abbreviations Hex. and Sq. should be used as shown, so there will be no mistake about the style of head desired.

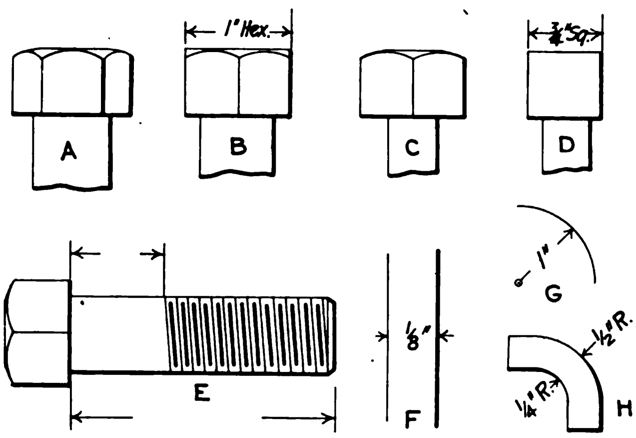


Fig. 21. Dimensions of Minor Details.

The length of a bolt should be given from under the head, as at *E* in Fig. 21. The total length should be given and also the length from the head to the top of the thread, which shows how high up the thread is to be cut.

At *F* in Fig. 21 is shown how to give a dimension when the space is narrow and at *G* and *H* how radii may be denoted.

There are various rules about the dimension figures themselves, to which allusion should be made. First of all, the figures should be plain, that no mistake can be made in regard to feet and inches. The usual practice is to represent feet by the prime mark (′) and inches by the double prime mark (″). Some hold that this is not distinction enough and insist on the use of ft. for feet, while retaining the inch mark. Some also object to the slanting line between the numerator and denominator of fractions, holding that the line might be mistaken for a figure one, if carelessly made. Some prefer the horizontal line and others write the numerator over the denominator and omit the separating line entirely. It is customary to arrange all the dimensions to read either from the bottom or the right-hand side of the drawing, though it is possible to have everything read from the bottom by making the figures upright, or up and down on the sheet, regardless of the direction of the dimension lines. In the shop inches are used more than feet in measuring, and dimensions are usually in inches, except for large work. In some shops they are given in inches even up to 10 feet.

Finish.

A drawing is or should be so marked as to tell the workman what surfaces are to be finished and what kind of finish is desired. This is often done by writing a character, resembling a letter f, across the line representing the edge of the surface to be finished, as in Fig. 22. Another way is to write the words "polish," "finish," "ream," etc., near the edges of the surfaces to receive the treatment indicated. Still another method that is much in use is to draw a red line near the edge of each surface to be finished. When a blueprint is taken from such a tracing the red lines will print fainter than the black lines, and a draftsman can easily trace over them on the blueprints in red ink. Still another method that can be used to advantage in a manufacturing plant is to put only the dimensions of finished surfaces on the drawing, leaving off entirely all dimensions of rough surfaces that are of service to the patternmaker but to no one else. The workman in the shop then knows that wherever he sees a dimension the surfaces are to be machined. One feature that should be looked after more carefully than is usually done is to indicate how closely the various parts must be finished to size. If a piece must be made within a half-thousandth of an inch the workman ought to know it, and if a thirty-second of an inch is near enough he surely ought to know it. The practice of giving dimensions in thousandths of an inch where needed and of using plus and minus limits where sizes are to be kept within limits, putting the limits on the drawing, is a good one to follow.

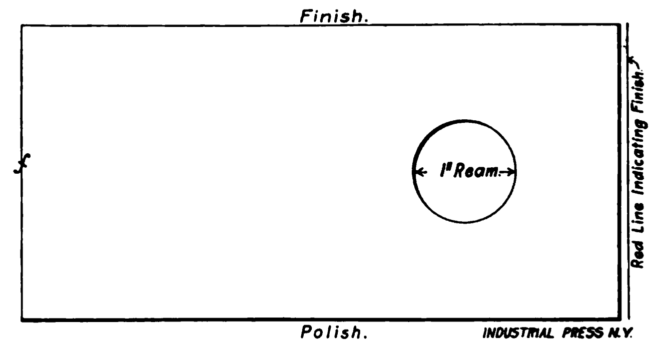


Fig. 22. Indicating Finish.

* * *

STANDARDIZATION OF EXTRA HEAVY FLANGES.

Steam pressures varying from 100 to 250 pounds pressure entered into engineering practice about the year 1889. For pressures less than 100 pounds there had long existed confusion regarding standards for flanges of pipe, fittings and valves. A schedule of standard flanges was adopted July 18, 1894, by a committee of the Master Steam and Hot Water Fitters' Association, a committee of the American Society of Mechanical Engineers, and the representatives of the leading valve and fitting manufacturers of the United States. As the use of high steam pressures became more general there came into existence so many different diameters, thicknesses, drilling circles and number of bolts for flanges on fittings, valves and pipe for extra heavy pressures that manufacturers could not safely keep stocks of goods, and mill architects and engineers were greatly delayed at times in making up specifications for contemplated work, on account of time taken to find out what the different manufacturers could or would furnish.

Recognizing the need of a standard for extra heavy flanges,

Mr. J. C. Meloon, mechanical superintendent of the General Fire Extinguisher Co., Providence, R. I., issued an invitation to the leading valve and fittings concerns of the country to meet and consider this subject. In response to this invitation several of the largest concerns sent representatives to a meeting at New York, April 24, 1901, and at that meeting a committee was chosen to formulate a standard. This committee consisted of J. C. Meloon, mechanical superintendent of the General Fire Extinguisher Co., Providence, R. I.; J. F. O'Brien, secretary of the Pratt & Cady Co., Hartford, Conn.; L. R. Greene, engineer of the Walworth Mfg. Co., Boston, Mass.; H. D. Gordon, M.E., of Jenkins Bros., New York, N. Y.; F. A. Strong, superintendent of the Eaton, Cole & Burnham Co., Bridgeport, Conn.; and F. N. Connet, engineer at Builders' Iron Foundry, Providence, R. I.

Mr. Meloon was made chairman, Mr. O'Brien, secretary. The committee had various sessions and submitted to the manufacturers interested the following recommendations and schedule for standard at a meeting held in New York City, June 28, 1901:

Paragraph No. 1.—Multiples of four for drilling.

Paragraph No. 2.—Drilling should straddle vertical axis.

Paragraph No. 3.—Bolt centers not to exceed 3⅝ inches except on 2½ inches size. The committee at first proposed 8 ⅝-inch bolts, but sample elbows and flanges were drilled and bolted together, and it was found that 8 ⅝-inch bolts interfered with inserting bolts.

Paragraph No. 4.—Distance from center of bolt to edge of flange should always equal or exceed the diameter of bolt plus ⅛ inch for 9-inch valves and under, and diameter of bolt plus not less than ¼ inch for sizes larger.

Paragraph No. 5.—

Size of Pipe.	Diameter of Flange.	Thickness of Flange.	Diameter of Bolt Circle.	Number of Bolts.	Size of Bolts.
Inches.	Inches.	Inches.	Inches.		Inches.
2	6½	⅞	5	4	⅝
2½	7½	1	5⅞	4	⅝
3	8¼	1⅛	6⅝	8	¾
3½	9	1 3/16	7¼	8	¾
4	10	1¼	7⅞	8	¾
4½	10½	1 5/16	8½	8	¾
5	11	1⅜	9¼	8	¾
6	12½	1 7/16	10⅝	12	¾
7	14	1½	11⅞	12	⅞
8	15	1⅝	13	12	⅞
9	16	1¾	14	12	⅞
10	17½	1⅞	15¼	16	⅞
12	20	2	17¾	16	⅞
14	22½	2⅛	20	20	⅞
15	23½	2 3/16	21	20	1
16	25	2¼	22½	20	1
18	27	2⅜	24¾	24	1
20	29½	2½	26¾	24	1⅛
22	31½	2⅝	28¾	28	1⅛
24	34	2¾	31¼	28	1⅛

Paragraph No. 6.—The bolt circle diameters, as above stated, will allow the use of calking recess on pipe flanges, provided such device is specified.

The schedule presented was unanimously adopted by the manufacturers present, and January 1, 1902, was the date set for the adoption of same. The following firms have agreed to adopt the standard and put same into effect January 1, 1902:

The Eaton, Cole & Burnham Co., Bridgeport, Conn.; the Chapman Valve Mfg. Co., Indian Orchard, Mass.; the Walworth Mfg. Co., Boston, Mass.; the Crane Co., Chicago, Ill.; the Pratt & Cady Co., Hartford, Conn; Jenkins Bros., New York City; the General Fire Extinguisher Co., Providence, R. I.; the Builders' Iron Foundry, Providence, R. I.; the Jarecki Mfg. Co., Erie, Penn.; the Crosby Steam Gage & Valve Co., Boston, Mass.; the Kennedy Valve Mfg. Co., New York City; the Ludlow Valve Mfg. Co., Troy, N. Y.; the Lunkenheimer Co., Cincinnati, O.; the Michigan Brass & Iron Works, Detroit, Mich.; the Kelly & Jones Co., New York City; the Eastwood Wire Mfg. Co., Belleville, N. J.; the National Tube Co., Pittsburg, Pa.; the Coffin Valve Co., Boston, Mass.; the Rensselaer Mfg. Co., Troy, N. Y.; the Mason Regulator Co., Boston, Mass.; McNab & Harlin Mfg. Co., New York City; the John Davis Co., Chicago, Ill.; the Watson & McDaniel Co., Philadelphia, Pa.; the Ross Valve Co., Troy, N. Y.; and Edward P. Bates, Syracuse, N. Y.

The following firms will furnish to standard if desired by their customers:

The Best Mfg. Co., Pittsburg, Pa.; the Pittsburg Valve, Foundry and Construction Co., Pittsburg, Pa.; and the Eddy Valve Co., Waterford, N. Y.

The committee's labors were very much lightened by the hearty co-operation of all the firms with whom they held communication, and the list of firms mentioned, embracing the largest manufacturers of valves and fittings in the East and West, shows the interest taken in the subject.

A limited number of the schedules will be printed by the committee, and copies can be obtained of the secretary, J. F. O'Brien, P. O. Drawer No. 66, Station A, Hartford, Conn.

* * *

A MACHINE SHOP "BAKERY."

The illustration herewith is from a photograph of two sets of shelves in the stock-room of the Fellows Gear Shaper Co., Springfield, Vt. The shelves are divided into pigeon holes, and in these are set sheet-iron pans similar to, and which we believe are in fact, ordinary baking dishes. From the use of these pans the stock-room has come to be familiarly known as the "bakery." The pans contain the small machine parts, such as bolts, nuts, pins, rolls, studs, screws, etc., and are inclined so that their contents are easily visible to one standing in front. Being of metal they are durable, can be kept

Stock Bins containing Pans in which Small Parts are Kept.

clean and can be removed from their places for emptying or filling, which feature saves a great deal of time in taking care of the stock. Perhaps the best feature of the system, however, is that it is entirely flexible, having advantages over the usual arrangement in this respect that a card index system has over records kept in books. When a certain number of pans allotted to a certain class of machine parts become full and are not sufficient to contain the quantity of stock that it is desired to carry, the pans can be rearranged or moved along, making room for more in the crowded section. It is thus possible to group similar pieces together and this can be done, no matter to what extent it is found necessary to enlarge the stock room.

* * *

In the October issue of the *Cosmopolitan*, John Mitchell draws a pathetic picture of the hopelessness of the average anthracite coal miner's lot. Commencing work at a tender age, perhaps not more than ten or twelve, he first works in the dust and grime of the breaker picking slate. From the breaker he is promoted to a position as door-boy in the mine, and as he grows older and stronger to that of laborer. The next step upward is to the place of miner's helper, and from thence to that of a full-fledged miner. At this occupation he works through the prime of life, if not maimed or killed by a fall of rock, and then as advancing age robs him of strength and vigor the descent on the scale begins. He is again in turn miner's helper, laborer, door-boy, and finally a slate-picker on the breaker with the young boys, in the same position as when starting in early life, and again receiving the pay of a few cents per day.

A SPECIAL MILLING MACHINE.

DESIGNED FOR MILLING THREADS OF COARSE PITCH.

FRED J. BRYON.

The special milling machine described in the following article was designed and constructed by Mr. D. Doncaster, of the firm of Myers & Doncaster, Brooklyn, N. Y., for milling long screws of coarse pitch. It is a distinctly new departure in milling machines, and the principle of the machine can be used, with slight modifications, for milling threads of screws having other pitches and diameters.

machine is a pan-shaped casting, with a pair of legs fastened at each end, as shown. *B* is the cutter, or driving, spindle, and runs in the boxes *C C* in the position shown. *A A* is the spindle driving pulley, and *B B* a pulley for driving the worm-feed shaft pulley *W*. This feed shaft runs in boxes located in the base at each end, as shown at *V* and *T*, respectively. *X* is the clutch, which is of a simple jaw design, in which *Y* is the yoke and *Z* a section of the starting rod.

The head in which the tubes, or pipes, are fed and held while being cut is situated at the right-hand end of the machine, and it is constructed to allow the work to be

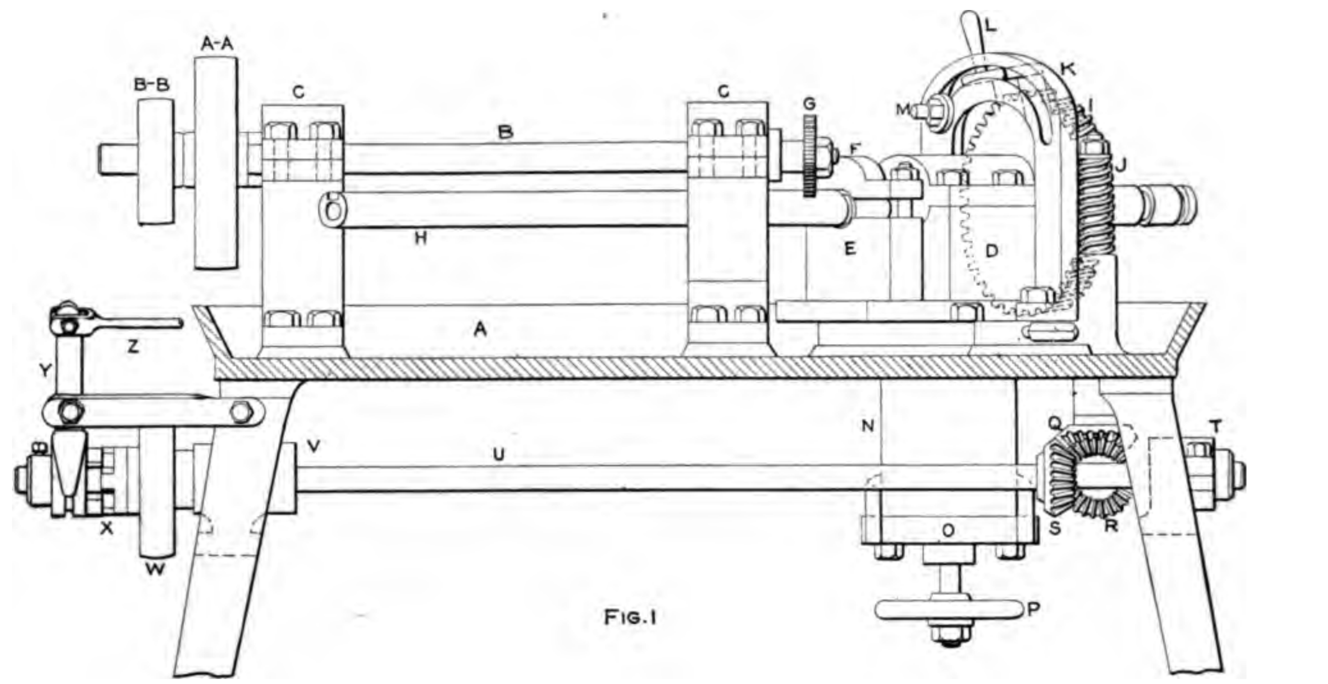


FIG. 1

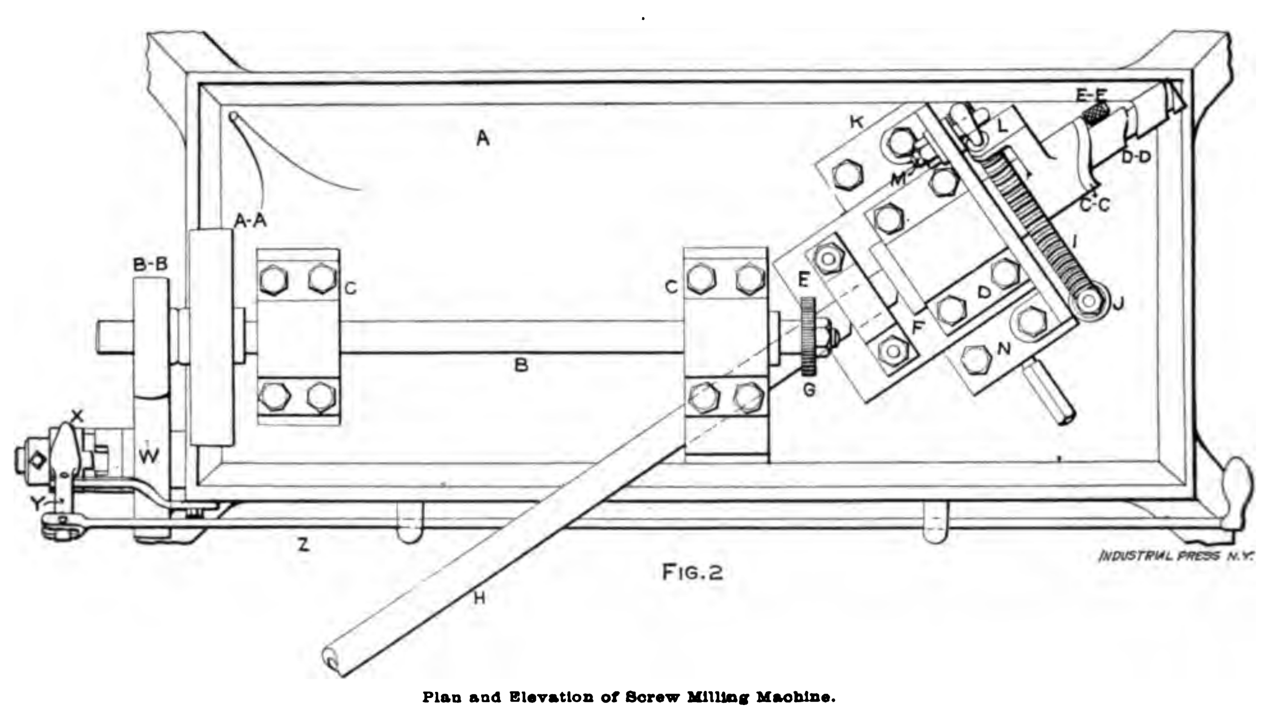


FIG. 2

Plan and Elevation of Screw Milling Machine.

This machine is used for milling 2½-inch pitch threads in 18 feet lengths of 3-inch iron pipe, the wall of which pipe is ½ inch thick. These pipes, or tubes, are used, when assembled with other parts, in a patented boiler tube cleaner for which there is a large demand, and the tubes, before being threaded, have a channel ½ inch wide and ⅜ inch deep cut down their entire lengths. The first lot of tubes were threaded in a lathe, but as this method of doing it was slow, and not consistent with cheapness, the machine shown in Figs. 1 and 2 was designed to do the work.

The design of the machine is clearly shown in the plan view, Fig. 1, and the side view, Fig. 2. The base *A* of the set up and the cut started in very short order. Before describing further this part of the machine a few words relative to the method of starting the cut and feeding the tube, so that the required pitch of thread will result, are necessary. The method of beginning the feeding of the tubes into the cutter is as follows: A piece of round machine steel is centered and turned down to 3 inches in diameter and left about 2 feet long. One end of this shaft is then reduced for about 6 inches from the end, to fit tightly within the hole in the pipe, it being finished slightly taper so as to drive in. A square thread of 2½-inch pitch is then cut along the entire length of the shaft. This thread is finished

as smoothly and accurately as possible, thus giving a master screw to work from. A channel is then cut down the length of the screw in exact duplication of that in the pipes. By driving the reduced end of the master screw into one end of a length of pipe, with the channels of both in line with each other, the thread is ready to be milled.

The master screw is inserted into the head *D*, Fig. 2, and projects through far enough to allow the split nut *C C* to engage the first thread, and a feather on the inside of the worm-wheel shaft fits within the channel of the screw. The split nut *C C* is then locked by the knurled-head pin *E E* and the head raised by handle *P* until the cutter *G* has entered one of the threads of the master screw far enough to just touch its bottom. The feed shaft clutch is then thrown in and the worm-wheel *I* revolved by the worm *J*, which is driven by the bevel gears *S* and *R*, as shown in Fig. 1. As the worm-wheel revolves it carries the master screw and pipe *H* with it, and the split nut *C* C, Fig. 2, remaining stationary, causes the screw to be fed forward until the cutter *G* has left the master screw and started to cut the pipe. As the work is fed further through the head the master screw leaves the nut, and the nut engages the thread cut and duplicated on the pipe and feeds it along until the whole length of pipe is finished. As shown in Fig. 2, the split, or feed, nut *C C* is fastened to the face of the sleeve *L*, which rests against the stop stud *M*, as when the cutter *G* is milling the thread the pull is all backward and it is not necessary to fasten the sleeve, the pull causing it to hug the face of the worm-wheel. Before starting the cutter it is necessary to set the thread of the master screw in line with it; to do this all that is required is to adjust the stop pin *M* by moving it backward or forward in the slot in the stop bracket. By so doing the nut sleeve *L* is moved accordingly, and the screw drawn in or out, as may be required, for the necessary distance.

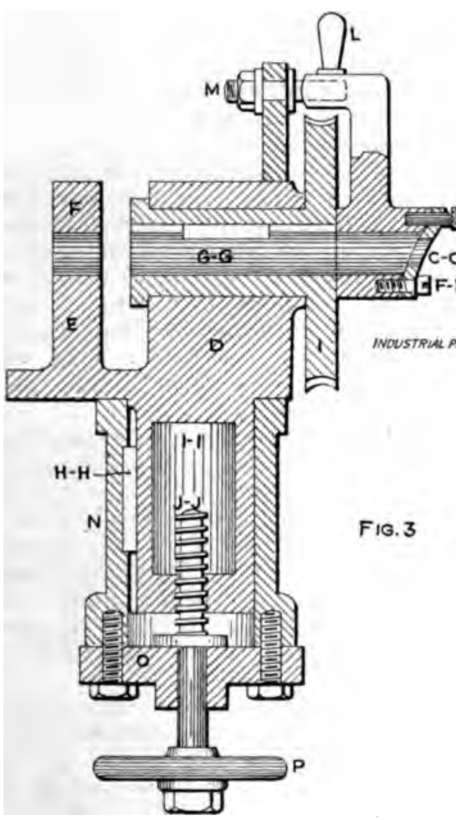


Fig. 3. Sectional View of Head.

In Fig. 3 is shown a cross-sectional view of the head complete. The base *N* is bored out and a feather inserted at *H H*. This feather enters the channel in the round portion of the head. This round portion is cored out at *I I*, and has a hole tapped with a square thread in the bottom to accommodate the raising and lowering screw *J J*, which screw is rested on the inside face of the strap *O*, as shown. The worm-wheel and shaft *I* is all in one piece of cast iron, and was first chucked and bored out to an easy fit for the master screw and pipe; it was then driven on an arbor, and turned and finished, so that the shaft portion would fit with the box, as shown. It was then removed from the lathe and the worm-wheel hobbed in the milling machine. The channel for the feather *G G* was let in, in the key-seater.

When in operation it is surprising the amount of work that this machine turns out, as when the cut is started and an oil pump placed so that both cutter and work are flooded, the machine finishes the entire length of thread without any attention. Mr. Doncaster is now working on a machine which he promises will be a great improvement over this one, as it will be so constructed as to allow the milling of long screws of any pitch. He intends using it, when finished, for milling extra long feed screws for lathes and other machine tools on which screws of this kind are used.

* * *

A NOVEL ELECTRIC LIGHTING PLANT FOR THE EXPLORING SHIP "DISCOVERY."

The exploring steamer Discovery has taken out with her to the Antarctic regions probably as unique an electric lighting plant as has ever been installed upon any ship. The absolute necessity of economy of fuel of every description on account of the impossibility of its replenishment in those regions made it advantageous to adopt a method of driving the generators used for the supply of electricity without the employment of steam. The great difficulty hitherto found in using wind as a motive power for electric purposes has been that the dynamo could not be made to run at a constant speed, due to the fluctuations in the speed of the wind; but this difficulty has been overcome, and the windmill thus rendered practicable for this service.

The difficulties introduced by the varying speed of the windmill have been removed by using two generators, the one opposed to the other when mounted on the same shaft, with the result that with the dynamo running at a speed varying from 500 to 2,000 revolutions per minute, a practically constant voltage was obtained.

The entire plant is very compact, and is so designed that it can be stored away in the hold of the ship until she arrives at her destination. In the event of it becoming necessary to light observation cabins or instrument sheds in the vicinity of the vessel, flexible cables have been provided with lamps attached so that these may be illuminated from suitable plugs placed about the ship. The windmill is so designed that it can be placed complete with its dynamo at a distance of 200 yards from the vessel for the purpose of obtaining the very best results from the wind, and connected to the vessel by means of a large armored cable wound on a drum.

The windmill is 20 feet high, with a driving wheel 12 feet in diameter, developing in a 15-mile wind something like 3 horse power, geared to drive the vertical shaft at 200 revolutions per minute. Commander Scott will thus be insured a good light when steam is out of the question, driftwood not to be depended upon, and the burning of oil or blubber impossible.

The windmill was manufactured specially for this plant by Messrs. Alfred Williams & Co., of Old Ford Road, Bow, and is of American type, so constructed that it can be easily shifted from one point to the other or packed away in a small compass. The apparatus was designed by Mr. Arthur Bergtheil, of Messrs. Bergtheil & Young, British representatives of the Bullock Electric Manufacturing Co. and the Wagner Electric Manufacturing Co.—*Electric Review*, London.

* * *

A statement is going the round of the British press to the effect that Galloways, Limited, of Manchester, have bought out absolutely a patent by Mons. Raoul Pictet, the Swiss inventor. The discovery credited to Mons. Pictet consists of taking cut of atmospheric air oxygen by physical and not by chemical means. Mons. Pictet claims that by this process the cost of oxygen will be very much less than ¼ penny per cubic foot, which, when compared with present prices, is in the proportion of cents to dollars. It will be applied to metallurgy, chemistry, lighting and public health. It has great heating properties and can be used for smelting all ore containing gold and other refractory metals, a process which it is claimed is much cheaper than any which at present obtains.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

NOVEMBER, 1901.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

1900.		1901.		1901.		1901.	
Dec.....	27,500	Mar.....	30,000	June....	28,000	Sept.....	28,165
Jan, '01..	27,500	April....	26,000	July.....	28,964	Oct......	28,845
Feb.....	26,500	May.....	26,500	Aug.....	29,492	Nov.....	31,743

No other paper in this field prints its circulation figures.

Beginning with this month we shall issue a monthly paper for railway shops, called RAILWAY MACHINERY, which will be a consolidation of MACHINERY and THE JOURNAL OF RAILWAY APPLIANCES, and will contain all the reading matter published in MACHINERY, with additional pages specially pertaining to railway shop work. MACHINERY will continue to be published as before in the same form and at the same price, but subscribers to RAILWAY MACHINERY will receive all the general machine shop articles now published in the former paper, and in addition a liberal amount of practical matter dealing directly with the methods and devices in use in the railway machine shops of the country. The price of RAILWAY MACHINERY will be $1.50 a year.

* * *

PROPOSED INCREASE IN A. S. M. E. DUES.

The indications are that there will be a lively time next December at 12 West Thirty-first street, New York, during the annual meeting of the American Society of Mechanical Engineers. The council of the society has always provided an attractive program for the mid-winter meetings, but no plans in recent years have had anything like the possibilities in the way of entertainment to be found in those for the coming meeting. The particular feature likely to prove interesting is the effort that will be made to carry through a motion to increase the annual dues of members and associate members from $15 to $25 and of junior members from $10 to $15. If this motion is pushed with any degree of energy it is safe to predict that the discussion will afford all the entertainment the most ardent members could desire—unless, indeed, those present are so overwhelmingly opposed to the motion that there will be no opportunity for discussion. We certainly cannot imagine that opinion will be overwhelmingly in favor of the motion!

There are now not far from 1,700 members and 500 junior members in the American Society of Mechanical Engineers and the proposed increase in dues would make about $20,000 additional funds to be subscribed and disposed of annually. Obviously such a step is of too great moment to the society to be taken without the most careful consideration, and opportunity ought to be afforded every member to vote upon the question. Under the present rules this cannot be done, however. The rules provide that an amendment may be made by a two-thirds vote of the members present at any meeting, provided a written notice of such amendment be given at the meeting previous. This form has been complied with and there the matter dropped until a short time ago, when circulars were sent to every member, in which were summarized the considerations that led the council to propose the increase in dues. The circular was not sent out until this fall because more attention would naturally be given it now than during the vacation months. Before the winter meeting it is to be followed by a second circular, accompanied by a blank on which the members will be requested to write their approval or disapproval of the change. While these expressions of opinion will have no legal effect, they will exert a moral influence, and it is hardly to be supposed that the vote at the annual meeting will go contrary to the expressed written opinion of the majority of the members at large.

The circular upon the subject of dues which has been issued to members appears to us to be noteworthy for eloquence rather than argument. When stripped down to the kernel there are apparently two main reasons why the council wishes to raise the dues 66 2-3 per cent. The first is that, as now run, the expenses of the society are about five dollars per member more than each member contributes through his annual dues, the deficiency being made up by rentals, sale of papers, initiation fees, etc.

In a recent editorial the *Engineering News* presents statistics to show that the dues of the Mechanical Engineers are now as high or higher on the whole than any other engineering society in the world, except in isolated cases where resident members may be charged an additional sum to accord with their greater privileges. Why cannot our society also be conducted within these limits? No outsider can undertake to say where curtailment should begin, but we advocate a reduction in the expenses somewhere; and then, if the members are not satisfied with the returns, let the complaints and requests for increase in dues come from outside the administrative circle.

The second reason, as expressed in the circular, is because "some more satisfactory housing of the society and its library will have to be considered before long." But should the nonresident members who derive only indirect benefits from the society's house be taxed to meet the expenses of new or enlarged quarters? Would not the mechanical engineers' proportion of the running expenses of a "union" society house, such as has been suggested, be less rather than more than the present expenses? And furthermore, Why add to the expenses of the headquarters simply because more room is needed during the one week of the New York meeting, when an auditorium could be hired at moderate expense for these meetings?

It should be plainly understood that a majority of the members attending the New York meeting have the power to increase the dues of the society and that if this is done those who do not attend the meeting have no recourse but to pay the increased dues, or resign. While we have no idea that the motion can be carried, it is more likely to receive a favorable vote at a New York meeting than at a spring meeting at some other place, owing to the character of the attendance at the annual meetings. It may not be appreciated by many who attend that the additional sum of $10 per year, or $25 in all, would be a positive burden to the large majority of active engineers who are in moderate circumstances, but are doing important work. To show that the fact is not appreciated by the council we have but to quote from the circular to the effect that "It is felt that to practicing engineers this increase is practically nothing."

* * *

In the September number of MACHINERY was published a description of a new type of the Richards side planer, and from the number of inquiries that we have received it has evidently attracted considerable attention. In this planer a departure is made by driving the traveling head through a worm operating in a rack instead of by a screw as usual. This design was originated by the Richards Machine Tool Co., of London, and we are informed by them that they are about to negotiate for its manufacture in the United States. They also write us that the planer is patented in this country.

NOTES AND COMMENT.

Some idea of the tremendous traffic across the Brooklyn Bridge may be gained from the fact that the trolley car tracks wear out in two years, during which time more than 2,500,000 cars have passed over them. Besides the trolley car tracks are those for the bridge cars and the elevated trains which carry many more passengers.

The shop of the Waterbury Tool Co., Waterbury, Conn., was burned out on the night of August 7. The machine room was gutted and the office badly damaged. The fire was checked, however, before the building was totally destroyed, and most of the machines will be able to be used again with repairs. The loss is covered by insurance, and the company are rebuilding, with the intention of at once resuming business.

Mr. Henry Prentiss, Jr., for the past seven years assistant treasurer of the Prentiss Tool & Supply Co., New York, and acting manager of the office, died on October 10th after an illness of only two weeks. He was the son of the founder of the company with which he was connected, and was a man of fine character and marked business ability. He was born February 9, 1876, in Brooklyn. His home was at Rutherford, N. J., and the funeral and interment were at that place. He attended Stevens Institute for two years, and had a broad knowledge of mechanical matters as well as an extensive acquaintance among the machine tool trade.

The Plant System have ordered from the Baldwin Locomotive Works a four-cylinder compound locomotive with the low-pressure cylinders between the frames and connected to a cranked axle. The high-pressure cylinders are mounted on the outside of the frames after the usual American practice and are connected to the same axle. The engine will have the Vanderbilt boiler, having a firebox of the circular corrugated marine type. The trial of this type of compound in the United States will be watched with considerable interest. The chief drawback to it appears to be the cranked axle against which there is a well-founded prejudice when built in the old-fashioned way, but against which there does not appear to be any serious objections when built according to the most approved European plan.

The formal opening of the new works of the Grant Tool Co., at Franklin, Pa., occurred on October 1st. Governor W. A. Stone, of Pennsylvania, and many other men of note were present, and a reception was tendered to the Governor in the evening. The many visitors who were present inspected the new works, and a luncheon was served in the pattern shop after the inspection. The buildings of this plant are new and modern in every respect, and include a machine shop 100 by 250 feet, a factory 80 by 125 feet for the ball department, besides blacksmith shop, pattern shop, etc. A large foundry will be built later. The chief products of the Grant Tool Co. will be lathes, boring mills, drilling, milling and worm-wheel machines, besides many railroad tools. The concern is at present bringing out a new axle lathe, two sizes of vertical boring mills, a wheel press and a steam hammer. Several special machines are being built, such as a large double boring machine for the Allis Engine Works.

The seven clocks designed for presentation purposes by Mr. James Arthur, president of the Arthur Co., New York, and described very fully in another part of this number, are as fine examples of careful machine designing and good machine construction as we have seen. Mr. Arthur does not profess to be an horologer, but he has made the subjects of gearing and fine machine work a study for many years and has applied the principles of good shop practice to the production of these clock movements. As an interesting study of mechanism they can scarcely be excelled and the method adopted to secure a receding action of the gears is one that might prove of considerable value in light-running machinery, where it was desirable to have the gears drive while the teeth were receding, instead of while approaching. Another feature of the movements which characterizes their construction as the work of an engineer rather than of an horologer simply, is the means provided for getting at and removing the different parts without having to take down the whole movement.

Nickel-steel alloy of 36 per cent nickel has the least coefficient of expansion of any known metal, being only one-thirteenth that of iron, or about .0000005 for one degree F. This remarkable freedom from variation of length under a variation of temperature has caused the quite general adoption of nickel-steel of about the stated percentage of alloy for the pendulum rods of high-grade clocks. With the nickel-steel rods no means of compensation for variation of temperature is necessary, the slight changes in the brass bob compensating for the changes in the length of the rod. Nickel-steel also has the valuable property of resisting oxidization or rust to a remarkable degree. It may be exposed for weeks to conditions which would quickly coat ordinary iron or steel with a thick coating of rust, without showing more than minute specks of rust. If nickel should ever be discovered in quantities sufficient to greatly cheapen its present cost, it would have an important influence on the future steel construction as nickel-steel would be generally used because of its toughness, superior strength and freedom from rust, the great disintegrator of modern metal structures. Railway rails having an alloy of 36 per cent of nickel would require practically no allowance for expansion between the ends since the total expansion of a mile of track from 20 degrees below zero to 100 degrees F. would be only 3.8 inches.

The Beaumont oil field in Texas is one of the wonders of the world. There are now sixty-four producing wells, which are conservatively claimed to have a daily producing capacity of 50,000 barrels each, making the total daily production the astounding figure of 3,200,000 barrels, or the equivalent of nearly 1,000,000 tons of coal in calorific capacity. The oil sand is forty feet deep and of considerable area. Some enthusiastic oil producers say that the production of this oil territory will revolutionize the fuel question, especially for power plants and locomotives, since the fuel oil which these wells produce will drive coal out of the market because of its cheapness, freedom from smoke and convenience in firing. There is now great excitement in Louisiana over the discovery of oil wells which seem to rival those in the Beaumont field. It is extremely improbable, however, that these phenomenal gushers will continue producing such enormous quantities for more than a comparatively short period. It has always been the case that heavy producing wells are short-lived, while the moderate producers have a much longer period of profitable flow. There are recent indications which show that these wonderful wells are likely to be no exception to the general rule.

A writer in the *Outlook* gives a brief description of a proposed suspension bridge across the Hudson River from Hoboken, N. J., to Twenty-third Street, New York, which has been approved by the War Department and granted a charter authorizing its construction by Act of Congress. The bridge is the design of Mr. Gustave Lindenthal, an eminent engineer, and is a stupendous conception. It crosses the Hudson by a single span 3,100 feet long, the towers being within the pier line limits. The towers supporting the cables will be 600 feet high above the water level. The bridge will have three decks, the upper one for foot passengers and the other two for railway tracks. The middle deck will carry six railway tracks and the lowest deck, eight tracks. Besides the railway tracks there will be roadways for vehicles and a bicycle path. The estimated cost is $25,000,000 which seems low for such a mammoth structure. It is certainly much less, relatively, than the cost of the East River suspension bridge. It will be constructed by one of the largest railway systems of America and the beginning of the work only awaits the co-operation of the other railways entering Jersey City. The great cost of the structure makes necessary its use by all these roads in order that it shall be a paying investment.

SPIRAL GEARING HELPS.

E. M. WILLSON.

There has been much written about spiral gearing, and many calculations have been made upon the subject, but so far as the author has found, one must go through a lot of figures to obtain the desired result whenever a spiral gear is to be laid off or figured.

While there are many possible combinations of spiral gearing, it is proposed to deal only with gears having an angle of spiral of 45 degrees, as probably that angle is used three times while any other is used once. By using the table herewith, the necessary shop calculations for spirals with an angle of 45 degrees are not much more intricate and do not take much more time than calculations for spur gearing.

Diametral Pitch.	Depth to be Cut in Gear.	Thickness of Tooth at Pitch Line.	Corresponding Circular Pitch of Spur Gear.	Corresponding Circular Pitch of 45° Spiral.	Corresponding Diametral* Pitch of 45° Spiral.	Reciprocal of Diametral* Pitch of 45° Spiral.
	C	$\frac{D}{2}$	D	E	$\frac{1}{F}$	F
2	1.07853	.785399	1.570798	2.22142	1.41421	.707106
$2\frac{1}{4}$	.95869	.698132	1.396265	1.97459	1.59096	.628539
$2\frac{1}{2}$	.86283	.628319	1.256638	1.77713	1.76776	.565685
$2\frac{3}{4}$	.78439	.571181	1.142362	1.61559	1.94454	.514259
3	.71902	.523599	1.047199	1.48094	2.12132	.471404
$3\frac{1}{2}$	.61630	.448799	.897599	1 26939	2.47487	.404061
4	.53926	.392699	.785399	1.11071	2.82842	.353553
5	.43141	.314159	.628319	.88856	3.53553	.282842
6	.35951	.261799	.523599	.74047	4.24264	.235702
7	.30815	.224399	.448799	.63469	4.94974	.202030
8	.26963	.196349	.392699	.55535	5.65685	.176776
9	.23967	.174533	.349066	.49364	6.36386	.157134
10	.21570	.157079	.314159	.44428	7.07106	.141421
11	.19609	.142799	.285599	.40389	7.77817	.128564
12	.17975	.130899	.261799	.37023	8.48528	.117851
14	.15407	.112199	.224399	.31734	9.89949	.101015
16	.13481	.098174	.196349	.27767	11.31370	.088388
18	.11983	.087266	.174533	.24682	12.72792	.078567
20	.10785	.078539	.157079	.22214	14.14213	.070710
22	.09804	.071399	.142799	.20194	15.55634	.064282
24	.08987	.065449	.130899	.18511	16.97056	.058925
26	.08294	.060215	.120830	.17087	18.38477	.054392
28	.07703	.056099	.112199	.15867	19.79898	.050507
30	.07190	.052359	.104719	.14809	21.21160	.047140
32	.06740	.049087	.098174	.13883	22.62741	.044194
36	.05991	.043633	.087266	.12341	25.45584	.039283
40	.05392	.039269	.078539	.11107	28.28427	.035355
48	.04493	.032724	.065449	.09255	33.94112	.029879

* Or modulus.

In the first column of the table, under the heading "Diametral Pitch," are the numbers corresponding to the pitch marked on cutters used for cutting ordinary spur gears. The letters *C*, *D*, *E* and *F*, at the tops of the succeeding columns refer to the corresponding letters shown on the spiral gear blank in Fig. 2.

In the second column, *C*, are the figures giving the depth to be cut in the gear, corresponding to *C*, in Fig. 2. The third column, *D*/2, gives the thickness of tooth at the pitch line, which is one-half the corresponding circular pitch of spur gears (*D* in column four). The figures in column four, as well as being the circular pitch of spur gears, are the normal pitches of spiral gears; that is, the pitch measured on the pitch circle, or cylinder, at right angles to the direction of the teeth (*D* in Fig. 2). The figures in the first four columns apply to spirals of any angle, and the figures in the fifth, sixth and seventh columns apply only to spirals of the 45-degree angle.

The fifth column, *E*, represents the distances from one tooth to the next, measured on the pitch circle, not measured as before at right angles to the direction of teeth, but at 45 degrees to that line and at right angles to the axis of the gear. It is the actual circular pitch of the spiral gear *E*, Fig. 2. For example, if you are to use a 10-pitch cutter and want to find the diameter of a 45-degree spiral gear, we have from column five 0.44428 times the number of teeth and divided by 3.14159, or multiplied by 0.31831, will give the pitch diameter.

Inasmuch as there is a corresponding circular pitch for diametral pitch cutters, and *vice versa* in the case of spur gears, there must also be a diametral pitch, or modulus, corresponding to the circular pitch of 45-degree spirals, or of spirals of any other number of degrees as far as that is concerned. This diametral pitch is given in the sixth column, 1/*F*, for 45-degree spirals, and is generally called the modulus of the spiral, and is equal to 1 divided by *F* (*F* in Fig. 2). This, for example, in 10-pitch cutters is

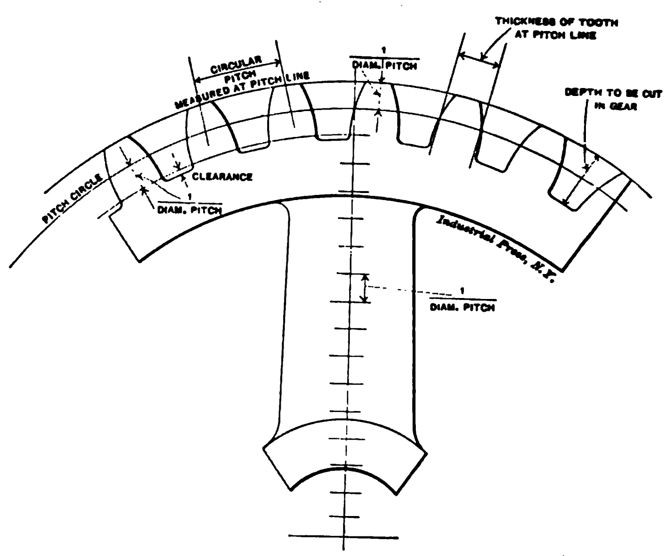


Fig. 1.

7.07106; then the number of teeth in the spiral gear divided by 7.07106 is equal to the pitch diameter.

Or, to work the same thing another way, which some will prefer, taking the reciprocal of the modulus as given in the seventh column, which is *F* in Fig. 2, and multiplying this by the number of teeth will give the pitch diameter. In 10-pitch gearing, 0.141421 times the number of teeth equals the pitch diameter.

The outside diameter of the spiral gear is obtained from the pitch diameter the same as in spur gearing by adding to the pitch diameter 2 divided by the diametral pitch as given in the first column. We will now refer more particularly to the various illustrations.

In Fig. 1 the various parts of the teeth of a spur gear are indicated, and in Fig. 2 the parts of the teeth of a spiral gear are indicated by letters, the explanation of which is as follows:

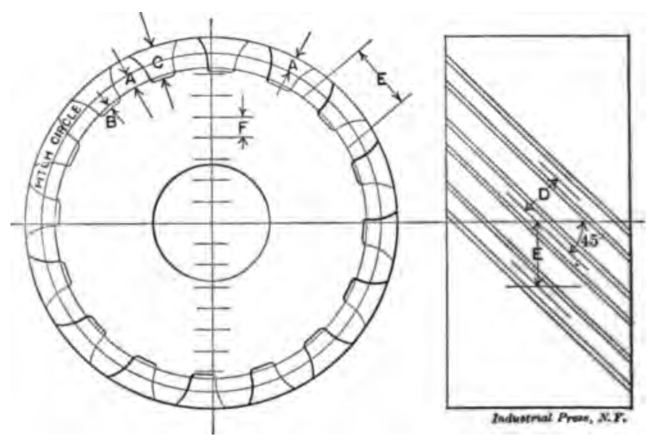


Fig. 2.

The depth *A* of the addendum or dedendum of the teeth equals $\frac{1}{\text{spur diametral pitch}}$; that is, $\frac{1}{\text{pitch}}$ measured according to the diametral pitch of spur gears.

The clearance *B* is measured according to the diametral pitch of spur gears.

The total depth, *C*, of the tooth is measured according to the diametral pitch of spur gears.

The normal circular pitch *D* is measured according to the circular pitch of spur gears.

The spiral circular pitch *E* is measured on the pitch circle.

The quantity *F* is termed the modulus, and is equal to one

space on the pitch diameter of a spiral gear for each tooth. It is calculated by dividing 1 by the spiral diametral pitch, or modulus.

Fig. 3 shows the relative positions of a gear blank, the cutter and the cutter arbor in milling the teeth of a spiral gear. In Fig. 4 is shown how the elements of a spiral gear may be laid out graphically, and the similarity between the lines in Fig. 4 and the corresponding parts of the gear in Fig. 3 should be noted.

Referring to Fig. 4, the distance GH equals the pitch circumference, and is calculated by multiplying E in Fig. 2 by the number of teeth in the gear.

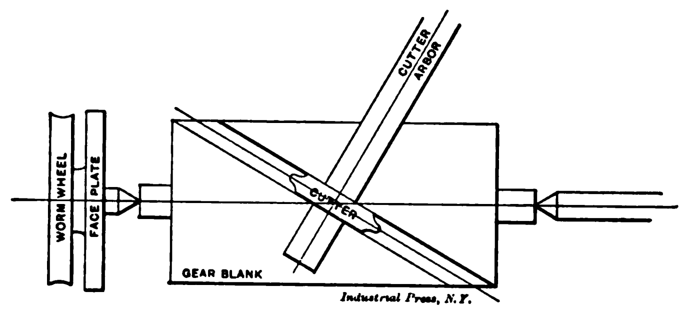


Fig. 3.

The distance HJ in Fig. 4 equals the lead of the spiral gear; that is, the distance traveled by the slide of the milling machine in making one complete turn of the wormwheel, or the gear to be cut (Fig. 3). The distance GJ equals the direction of motion of the cutter.

The distance GK equals the distance traveled, going at right angles to the direction of the cutter, in making one complete turn of the worm or gear; that is, going along the line of the normal pitch of the gear. The angle a is the angle to which the milling machine slide is to be set.

The distance GK equals the distance GH multiplied by secant a. The distance GK divided by the normal circular pitch (D in Fig. 2 and D in table) is equal to the number of teeth for which the cutter should be developed to cut the spiral gear with n teeth.

There is another problem, which many already know, but which some do not; that is, that a spiral gear, when cut with diametral pitch cutters which are developed for spur gears, is not cut with the same cutter that a spur gear of the same number of teeth would be cut with.

By examining Fig. 4 (and Fig. 3 also) you will see that the circular pitch is measured on the line GH, which, let us say, equals the pitch circumference of a gear with 16

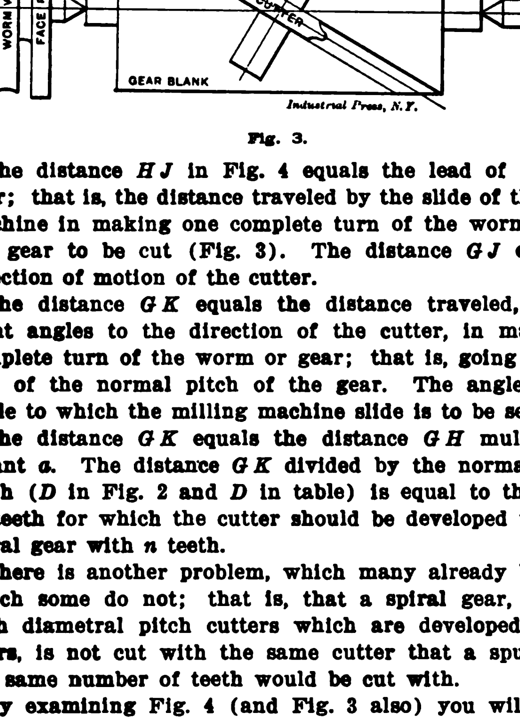


Fig. 4.

teeth cut with a 10-pitch cutter. Now each division on that line equals 1-16 of the pitch circumference. But the normal pitch for our 10-pitch cutter is measured on the line GK, and the normal circular pitch of a 10-pitch cutter is 0.314159; and dividing the line GK by 0.314159 will give us the number of teeth for which our cutter is developed. The same is true of any pitch and corresponding numbers for any angle.

* * *

STANDARD ROLLER CHAINS.

The time to establish a standard is before half a dozen different ways of doing things have been adopted. The automobile and machinery manufacturers of the country are likely to adopt some standard for driving chains in the near future, and the Whitney Mfg. Co., Hartford, Conn., suggest for this purpose the carefully worked-out proportions adopted by them for their new roller chains. Their ¾-inch pitch chains, illustrated in Fig. 1, have the same size of roller that is used in chains of certain other standards, and will therefore interchange on sprockets which have been cut for other ¾-inch pitch roller chains. The rollers should not be larger than 15-32 inch in diameter on a ¾-inch pitch chain, as it would make the sprocket teeth too thin. For sizes above 1-inch pitch the Whitney chains have larger rolls than used

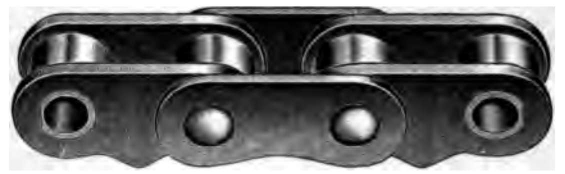


Fig. 1. Three-quarter inch Pitch Roller Chain.

on other chains of corresponding pitch, since there is a gain in the use of large rolls, rivets and bushings, and it is found that the sprocket teeth are sufficiently thick in these larger sizes when the large rolls are used. The standards adopted

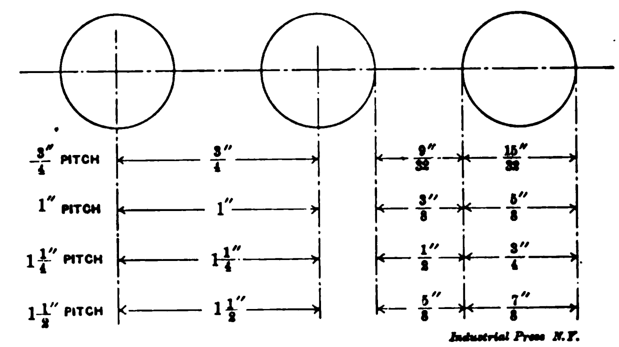


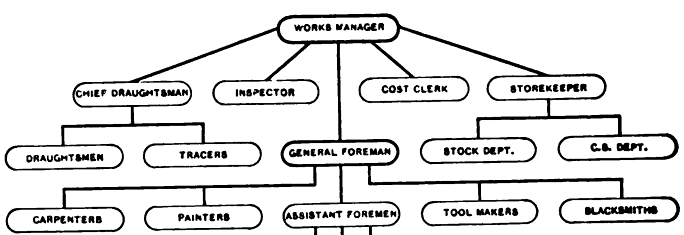
Fig. 2. Standards adopted for Roller Chains by the Whitney Mfg. Co.

by this firm are clearly shown in the sketch, Fig. 2. The dimensions are such as to make the chains very durable, which is an important consideration when they are used for automobile work.

* * *

A SHOP FAMILY TREE.

The accompanying diagram is reproduced from the *Iron Trade Review* and is a copy of a blueprint conspicuously displayed in the several departments of the Bickford Drill and Tool Co., Cincinnati, O. It is said to be the idea of Mr. H. M. Norris, the manager, and is designed to avoid the



friction and conflict of authority between the heads of departments in a shop organization. The diagram is so evidently plain in its meaning that "he who runs may read," and he who reads will be discouraged from trying to "run" those over whom he has no authority.

* * *

The International Correspondence School, Scranton, Pa., have added courses in French, German and Spanish. Instruction in these subjects is given almost entirely by the aid of a phonograph, each student being supplied with one upon commencing his course. The lessons are sent out in the shape of records and pamphlets—the one a key to the other—each record being a master record bearing the voice of the native instructor. After studying his lesson, both from the pamphlet and the record, until he has thoroughly mastered it, the student recites into the phonograph, using one of the wax cylinders furnished him, and returns it to the schools. These examination records show exactly the student's progress—whether he is acquiring ease, fluency, correct articulation, distinct utterance, etc. The records are carefully examined by his instructor, who writes the student letters of criticism and suggestion. Thus the work goes on lesson by lesson to the end.

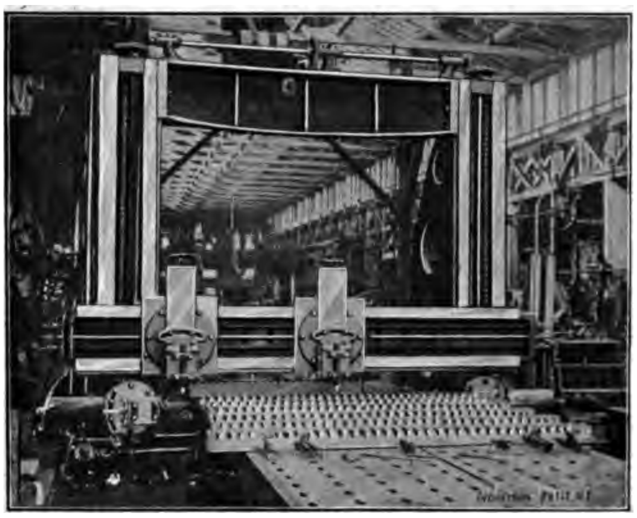
LETTERS UPON PRACTICAL SUBJECTS.

CUTTING A LARGE RACK.

Editor MACHINERY:

The accompanying cut shows how a rack of huge proportions was cut. The machine used for cutting was a 12-foot planer. The rack was made in six sections, five for 30 teeth and one for 31. The pitch was 4 inches and the face 10 inches, and it was cut from forged steel, as an enormous strength was required of it. The rack is now being used on a large forging planer in one of the largest steel works in the East.

The tool holders were placed from the spacing jig, which can be seen behind the last section of the rack. An attempt was made to cut out a triangular piece between the teeth



Method of Cutting Large Rack in Planer.

by using a thin tool set on an angle, which cut first one side of the gage and then the other; but this had to be given up, as the tool would not stand so much side pressure after reaching any depth. Therefore, a ⅝-inch tool was used in the center and larger tools afterwards applied. Then a side tool was used for cutting off the corners. A formed tool shaped up the space to within a few thousandths of the exact shape, and this was completed by a tool of proper shape.

As an interesting fact it may be stated that by actual timing it took 305 hours to cut this rack, or 1 hour and 40 minutes for each tooth. "MACHINIST."

* * *

GEAR PATTERNS AND BLANKS—CALIPERING WORK WHILE IN MOTION—CLEARANCE ON THREAD TOOLS.

Editor MACHINERY:

The MACHINERY data sheet for September contains the kind of information that most machinists like to have at hand for reference. The same could, of course, be said of all the other MACHINERY data sheets, but this one in particular appeals to me.

The value of Grant's Odontograph might not be apparent at first thought, as ordinarily cutters for gears are bought directly from gear makers; but some time or other a special gear may be wanted for which cutters are not at hand, and perhaps the makers, even, do not happen to carry that particular shape of cutter in stock. In such cases a "fly" cutter may easily be made to a template, which is quickly made from Grant's Odontograph method.

I remember once making a pattern gear of 1-inch circular pitch by this method. In this case a piece of steel was forged with a projection for a tooth, as shown in Fig. 1. It was then bored, squared up and marked from a template, and then turned in the lathe nearly to the line. The relieving and finishing was done with a file. The teeth of the gear were first roughed out in the gear blank with another cutter before this cutter was used. The gear in question was used as a driving pinion, and, when finished, made a satisfactory job.

The formulas given in the same data sheet for bevel gear blanks, however, do not furnish quite all the information required for turning up the blanks. The length of face F is not given directly, so that the machinist would need either to measure the drawing or to make the necessary calculations to obtain it. The length of the face is usually made one-third of the distance from its outer edge to the point where the shaft center lines meet at C, or one-third of H, as given

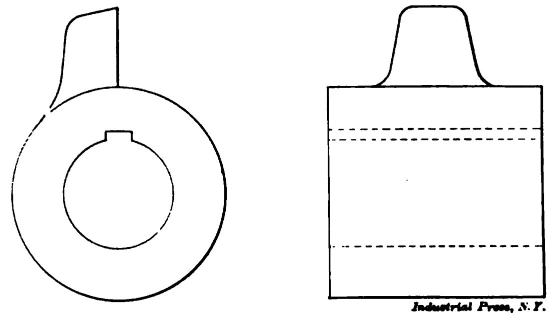


Fig. 1. Cutter made from Template for Special Gear.

in the drawing, which is reproduced in Fig. 2, and if the teeth are to be cut with a rotary cutter this length should not be exceeded, as, according to the Brown & Sharpe catalogue, their cutters are made for a length not exceeding this proportional distance. This gives a tooth thickness at the inner end of two-thirds of that at the outer end.

The length of face can also be obtained near enough for practical purposes by extracting the square root of the sum of the square of the radii of the pitch circles of the gear and pinion and dividing the result by 3. For example: If the pitch diameters of the gears are 8 inches and 6 inches respectively, the length of face would be:

$$\frac{\sqrt{16+9}}{3} = \frac{5}{3} = 1\frac{2}{3} \text{ inches, or say } 1\frac{5}{8} \text{ inches.}$$

For miter gears, merely square the radius of the pitch circle, then multiply by 2, extract the square root and divide by 3. The angle of face, or angles O and O', Fig. 2, are not, as given in the data sheet, so convenient for the workman in most cases as their complement, or the differences between 90 degrees and the angles as given, would be. These complements would give the angles measured from a line at

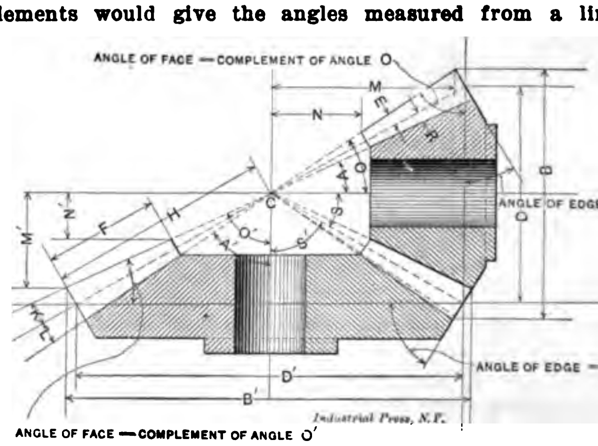


Fig. 2. Drawing for Bevel Gears, from Data Sheet.

right angles with the center line of gears, so that a bevel protractor could then be applied on the back side of the hub of the blank to measure the angle made with it by the face, or, if a compound rest is used, the rest could ordinarily be set direct to the angle as given.

The angle of edge is not given at all, and while this angle is not so important as the other angles, yet it is better to have something to go by in finishing it. If measured from a line at right angles with the center line of gear, this angle is equal to the center angle S or S', respectively, for the gear and pinion, as shown in Fig. 2.

On page 62 of October MACHINERY it says: "Never caliper

specially constructed screw dog. The faceplate is attached to a dial plate H, Fig. 1, by screw I, Figs. 1 and 2, which arrangement permits adjustment to position for grinding after the reamer is dogged to the faceplate, since the opening in the faceplate is a slotted hole, as seen at I, Fig. 2.

The faceplate is made to revolve freely on center J, Fig. 1, restrained by the index pin K, which is housed in an adjustable bracket L, Figs. 1 and 2, and kept in place by a spiral spring. The bracket, being adjustable, allows the index plate to have several circles of holes and permits of nearly all required divisions on one plate. On the index plate shown in the drawing there is only one circle, containing 12 holes.

N N', Figs. 1 and 2, are pieces that have eccentric centers and are adjustable by the flanged screws which clamp them in place. It is seldom necessary to change these centers, once the proper angle of clearance is found.

The operation of this device is as follows: Putting the reamer on the centers J J' and dogging to the pin M, the device is placed between the centers of the grinding machine and allowed to hang freely in position, and then, by moving the faceplate after loosening the screw I, the reamer is so adjusted that the cutting edge is on a line with the center line x x, shown in Fig 2. The whole device is then turned until a quarter turn is made and the work brought to the wheel. As broad a face as the wheel will allow should be presented to the work in order to give a smooth cut. Holding the tool by the part D, a slight up and-down motion, together with the feed of the screw, will give the result shown in exaggeration in Fig. 4, where y is the center of the reamer, O the center on which the device is swung, R the radius to which the work turns, and P P the arc which the work makes in passing the face of the wheel.

Brooklyn, N. Y. J. R. Gordon.

* * *

EMERY WHEEL HEAD FOR ROLL GRINDER.

Editor Machinery:

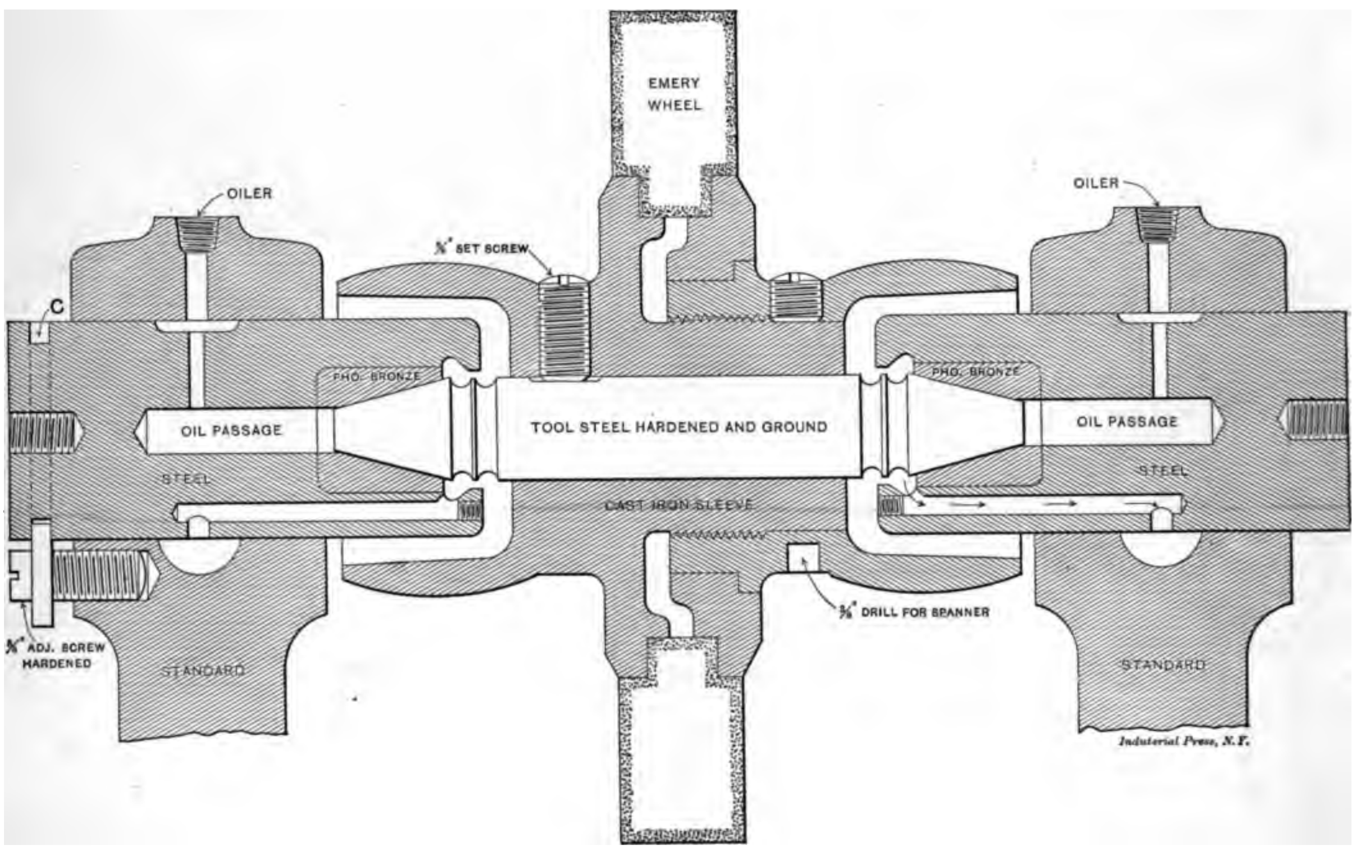
The design for the grinder head shown in the accompanying cut is, as yet, experimental, so far as its success is concerned, but it involves some features which we believe to be novel, and not without possible advantages. It is the result of a somewhat unsatisfactory experience with a flour-mill roll grinder, which carried an overhang wheel with taper bearings, which could not be adjusted sufficiently tight to make a finished surface without becoming too hot for satisfactory use. This condition could have been overcome, and, in fact, has been overcome by the makers; but inasmuch as the machine in question was a combined grinder and corrugator, and involved changes between operations, it was decided to use it solely as a corrugator and do the grinding on a separate machine, thus increasing our output more than 100 per cent with no additional labor cost, the proposed grinder being automatic in its operations.

Under ordinary conditions we would hardly attempt to build a machine which could be bought in the open market, but in this particular case it appeared possible to design a machine which would do satisfactory and rapid work at a cost which is far below that of standard machines of similar capacity. The drawing shows a section through the center of the wheel and bearing, and the construction is made sufficiently clear to make it readily understood.

The partial section of the two standards represented as carrying the spindle bearings are part of the yoked cross-slide of the wheel-housing, which has a motion at right angles to that of the table carrying the revolving roll back and forth. There are two grinding heads on opposite sides of the machine, both being used for simultaneous grinding but driven by separate friction clutch countershafts. The bored ends of these standards are split on one side and furnished with binder screws, the finishing cut of the bore being taken at one setting with the holes slightly contracted. The alignment of the two holes is therefore perfect, and the steel bearing plugs, carrying phosphor bronze taper bearings and closely fitted to their respective housings, are correspondingly accurate and subject to easy removal by slightly slackening the binder screw. These steel bearing plugs are provided with suitable recesses and passages for oil, and one of them has an annular channel at C which receives the collar of the adjusting screw, thus providing a cheap, but efficient adjustment.

The spindle is of tool steel, hardened and carefully ground, and is provided with double oil sling, the second one coming into play after adjustment for wear has possibly carried the first into the face of the bronze bearing. This spindle is a close fit in the cast-iron sleeve, which, with its washer and nut, serves the double purpose of emery wheel holder and drive pulleys, the whole being finished to insure perfect running balance.

While the expense of this bearing is considerably in excess



Emery Wheel Head for Roll Grinding.

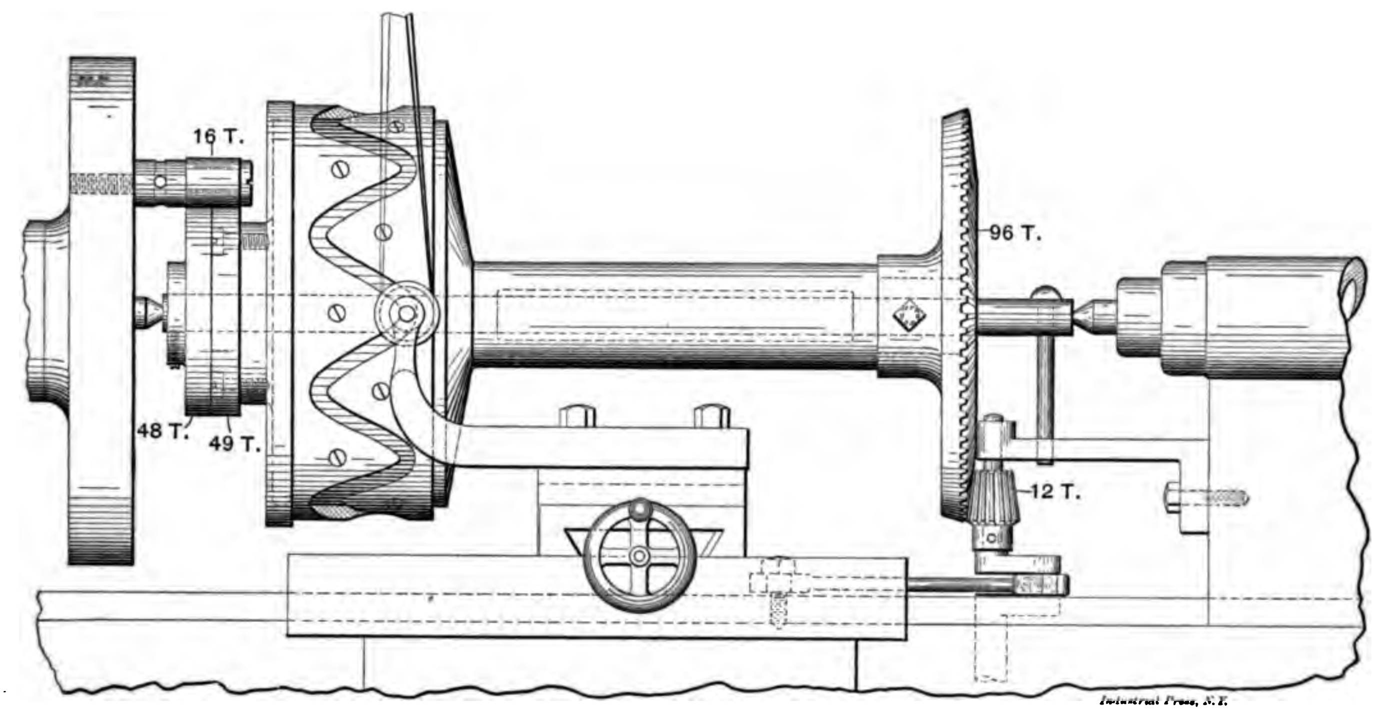
of those in common use, it nevertheless has some advantages, the importance of which is considerable for the special work intended.

The most important point gained is the protection of the bearing from dust and the protection of the wheel from oil. Provision for this purpose, to a still greater extent, is easily made; but until trial demonstrates otherwise the present precautions are thought sufficient.

The ease with which the wheel and spindle may be removed and the extreme rigidity of the spindle, combined with a small and easily-adjusted bearing, would seem very advantageous from our limited experience. It is obvious to us that any considerable heating in the journals might cause expansion sufficient to cause the whole spindle to bind; but this and other contingencies can only be in evidence through such experience as we hope to shortly have at our disposal.

WM. H. CORBETT.

Portland, Oregon.



The Way the Cam was Made in Shop No. 4.

AN UNUSUAL JOB.

Editor MACHINERY:

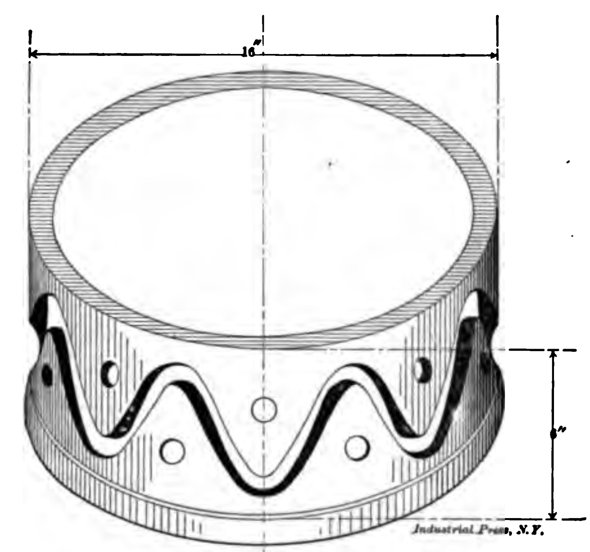
Machinists employed in jobbing shops are often called upon to display their ingenuity by devising ways and means of procedure that are highly interesting. Could these be collated they would afford a compendium of mechanical practice of material interest to others of the craft similarly situated.

True genius is often shown in making uncommon use of common tools by resourceful masters of the craft, at once highly creditable to themselves and satisfactory to those more or less directly interested. It is to be remembered that what might not be tolerated in shops given to *manufacture* of specialties is often commendable in the construction of sample machines and of that class of work usually taken to the jobbing shop. Of such nature is the piece shown—a plain cylinder, having a groove or sinuous channel, with regular rise and drop, running around its circumference. Its dimensions are shown in the illustration. With a special machine it would present little difficulty; with an ordinary shop equipment it is not so easy.

The conditions with the machine it is used upon demand that the groove shall be of uniform width, that it shall be regularly spaced, and that the inner surfaces be smooth. Similar pieces have been made in four separate shops, all devoted to high-grade jobbing, only one of which possessed a cam cutter, and that one not available.

In Shop No. 1 there is a large, powerful milling machine, with rotary table attachment, and their plan was to make a special butt or end mill with short teeth, immediately back of which, on the shank of the mill, they put a roller adapted to run on a sectional former, representing a little more than one full loop of the groove and fitted it to be moved from place to place along the periphery of the blank as the work progressed. By causing the table to rotate and carefully following up and down the incline of the former, after the manner of a profiler, a fair job could be made. The locating of the template, however, had to be very carefully done in order to have the groove ends match, while the necessary shifting of the clamps at the successive cuts and blocking up was a hazardous operation. The second cam made by this process was considered sufficiently good after dressing with a hand file.

Shop No. 2 had a lighter milling machine, with no rotary attachment. Their scheme was to make a flanged drum, turned to fill the bore of the blank cam, and fasten these parts together with screws along with a ring having its edge cut to the profile of the whole series of grooves. This drum they attached to the dividing head, blocked up to the necessary height and used a cutter similar to the first described. They also removed the feed screw of the table and arranged a cord, pulley and weight to keep the roller in contact with the former, feeding by revolving the dividing head by hand. This



The Cam to be Made.

practically transposed the milling machine into a special cam cutter, which produced a good job—barring a few "chatters"—but the expense of fitting amounted to quite a sum.

In Shop No. 3 they essayed to do the job in a lathe, fasten-

ing the blank to the faceplate. They figured it out that as the rise and drop was regular, and that there were to be eight loops around the circumference, the motion to the cutting tool might be imparted by a crank, geared to turn in the ratio of 8 to 1 and having a throw equivalent to the mean pitch height of the loops. By placing an arbor between the lathe centers having on it the driving bevel gear and arranging a vertical crankshaft in fastenings secured to the lathe, with the smaller gear thereon, and also provided with a pitman reaching to and secured at the lathe carriage, the necessity of a former was obviated. For a cutter they made a special milling head, fastened to the tool post and capable of being fed in as required. They found upon trial that the speed, even with the back gears in and the belt on the naked shaft, was too high for the cutter to work successfully, although they finally succeeded in producing a fairly accurate job.

In Shop No. 4, profiting by the experience of their predecessors, they selected the lathe as being the most suitable tool, but made a mushroom-shaped casting, turned to fit the bore of the blank and screwed the blank to it. The bore of the mushroom sleeve fitted an arbor held in the lathe centers, but kept from turning. They drove the sleeve by a gear having one tooth more than another of the same diameter fast on the stationary arbor and arranged side by side. The driving pinion ran loose on a stud in the faceplate and rotated around the two gears, meshing with both, and, by reason of the unequal number of teeth in the pair of gears, forced the mushroom sleeve around one tooth for each revolution of the lathe (sun-and-planet gearing), which was as slow as desired, depending upon the speed the lathe was run at. The cutter driving and method of producing a uniform wave motion was as in the preceding method, and is clearly shown in the illustration.

It is difficult to see how this process could be improved by improvised methods, using ordinary shop tools; but perhaps other shops, should this job fall to them, can make further improvements. W .E. WILLIS.

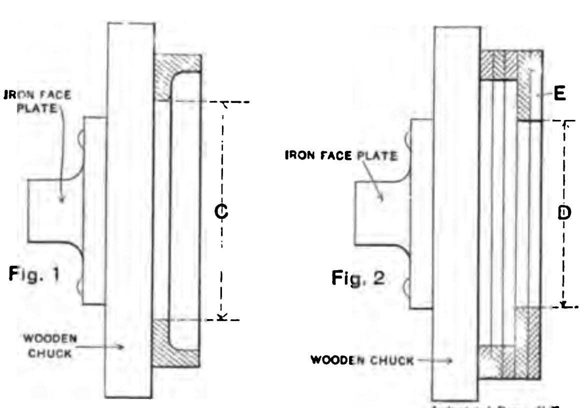
Philadelphia, Pa.

* * *

ANOTHER METHOD OF HANDLING SEGMENT WORK IN THE PATTERN SHOP.

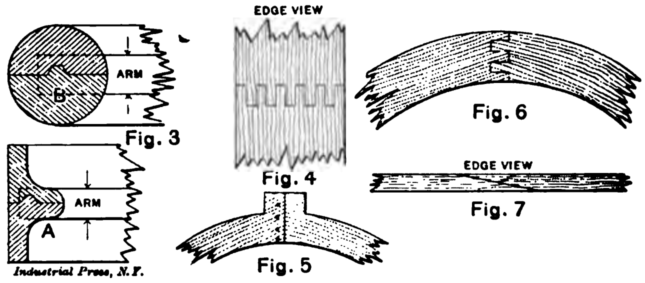
Editor MACHINERY:

In the October issue of MACHINERY, Mr. J. L. Gard, in describing the methods of building patterns of gears, pulleys, etc., states that he "puts a face-plate on the arms, builds between the arms, and then builds segments on each side," etc., and then says: "This leaves the segments between the arms to be finished by hand." I am aware that this is the customary method, but the entire work can be done much more expeditiously on the lathe and a better job made as follows:



The Rims on the Faceplate.

Build up the rim in halves. At Fig. 1 is shown the first half in section, the bearing being next to the wooden chuck, or face-plate. The inside is turned out to a template, but the outside diameter is left unfinished; this half pattern is then removed from the chuck. The second half rim is shown at Fig. 2, unfinished, with the parting on the outside. This is trued up and the diameter *D* is bored out to the same size as diameter *C*, in Fig. 1, after which a stick is fitted across tightly and, while the work is revolving in the lathe, the center is carefully located. Then a pair of trammels, or beam compasses, are set at a radius of about ½ or ¾ inch less than that of the finished pattern, and this is used to describe a circle on the arms and also on the parting of the pattern. The arms are band-sawed to this line, and are let half way into each half rim in sockets, as shown in Fig. 2 at *E*. At this stage temporary blocks are fitted into these spaces *E* and this half is rechucked and the inside turned out. It is then removed from the chuck and the two half rims are glued together with the arms glued in between, and when set the outside can be turned off. A hole can be bored in the center of the arms and the hubs turned to fit, so they will be sure to run true.



The Jointing.

It is but a trifle more work to make a tongue on one half pattern, and a corresponding groove on the other one, as shown in Fig. 3 at *A* and at *B*, the round rim pattern. This prevents any tendency for the parts to slip out of center with each other when they are being glued and the handscrews applied.

The method I have described prevents having the ends of the arms project through the rim, thus making smoother work and making the pattern easier to draw out of the mold. In many of the shops in Boston segments are sawed out of 2 or 3-inch stock and tongued on the circular saw, as shown in Fig. 4, edge view. A saw ⅛ or 3-16 inch thick is used to cut out the tongues in this method, which saves many glued joints. These need thick glue in order to get them together easily, and it is a good plan to leave a projection at the ends of the segments, as shown in Fig. 5, so that they can be clamped up tightly with handscrews.

A thin ring might be made of a single thickness, tongued, as shown in Fig. 6, or a stronger job could be made by using a scarfed joint, as shown in Fig. 7, edge view, which is thoroughly glued and clamped together. This latter kind of a joint is frequently used on stove patterns which are often only 1-10 inch in thickness. W. A. SYLVESTER.

Reading, Mass.

* * *

GRINDING DRILLS.

Editor MACHINERY:

I have noticed the item on wet vs. dry drill grinding published in your October number, under the heading "Items of Mechanical Interest," and am induced to give my little experience in that line.

It is true, of course, that wet grinding is better adapted to large drills than to the small sizes, for the reasons given in the item, and also because in grinding a small drill the time saved by being able to grind more rapidly is again lost in wiping the drill and also one's hands.

Regarding the selection of the proper emery wheels, I have found this to be practically impossible on account of the great variation in size of the drills ground on the same wheel. Suppose, for instance, a drill grinder with a capacity of ¼ to 2¼ inches to be installed in a shop. What grade and hardness of wheel should be used on that machine? Ask the mechanics who grind their drills on it. The man at the radial drill will want about grade 46 and medium hardness; the man at the sensitive drill, about grade 70 and a harder wheel.

Here we have to compromise; but allow me to state that it is much easier to get a wheel too fine and hard than too soft and coarse, because a little roughness at the cutting edge is far less objectionable than to have the temper drawn

at that point. It frequently happens, after grinding a drill, that the edge appears to be unharmed; but when the thin ragged burr is removed a very perceptible blue can be detected with a magnifying glass. Such a drill loses its valuable initial sharpness as soon as it commences cutting.

The grade of emery in the wheel also is not so important a factor as the hardness of the bond. A hard, coarse-grained wheel will glaze over and heat the drill much more than a less hard and finer wheel. I have frequently ground a No. 60 drill on a medium hard wheel made of No. 46 emery, with very good results, but care must be taken to move the drill holder very slowly so as to obtain a smooth "grind."

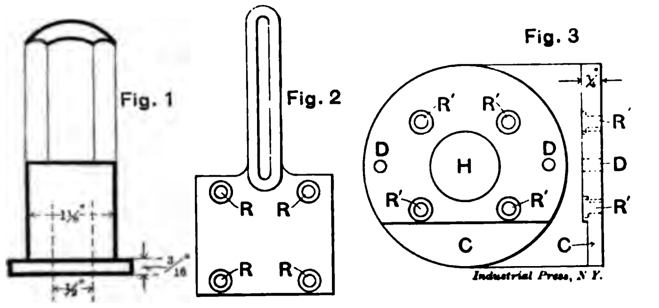
I have alluded only to drill grinding on the machines built for that purpose, as now these are (or should be) used in nearly all shops—especially since the many adjustments which it was necessary to make in the older machine are not required in the latest of these, and drills ground thereon are not only ground in less time but also do more and better work than the average hand-ground drills. But to successfully grind drills on these machines requires common sense, as does anything else around the shop, for these machines cannot, any more than others, be made "foolproof." It must be borne in mind that when grinding a drill by hand it is yieldingly held and the pressure exerted against the wheel is felt by the operator, whereas in a drill grinder the machine takes all the strain and the operator does not feel it and is tempted to grind heavier than is good for the drill. The best way is to grind off the bulk of the metal by rather quick oscillation of the drill, so as to reduce the danger of drawing the temper, and then to finish with two or three slow movements, to obtain a true "grind." DRILLGRINDER.

* * *

A TIME-SAVING METHOD OF FINISHING NUTS.

Editor MACHINERY:

We had a job in the shop a while ago, which I think will be interesting to readers of MACHINERY because of the time saved in doing it. We had about 350 nuts, similar to the sketch, Fig. 1, which were for truing devices for grindstones. They had to be turned and rounded over on the end, as indicated by the heavy lines in the sketch. In the regular way the nut would have had to be put on and taken off the nut-arbor three times, thus involving considerable waste of time. The foreman did not like this idea, so he tried the following scheme which worked very successfully, finishing a nut at one setting.



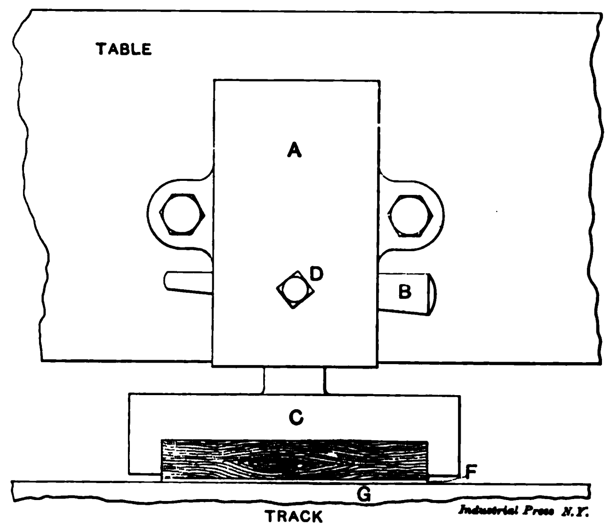
Rig for Finishing Nuts.

We used a Hendey-Norton lathe with the taper attachment, the nuts having been tapped and faced on a screw machine. I got a tap bolt and clamped two Armstrong toolholders in the tool-post rest, then ground and set the tools so that they would turn both diameters at the same time, and then set the thread stop. The tool that turned the small diameter was ground nearly square so that when it came up to the shoulder I could pull out and feed in until it brought up on the thread stop, thus getting a square shoulder. For rounding over the opposite ends an attachment was devised for use with the compound rest. The taper attachment on the cross-feed cover, Fig. 2, was first taken off, and then a cast-iron blank was taken and a hole bored in its center to fit the tit on the compound tool-post rest, as shown at *H*, Fig. 3. It was then put on an arbor and squared until about ⅜ inch thick and turned to about the diameter of the graduated part of the compound rest, after which it was placed in a shaper and clearance-planed off, as shown at *C*, Fig. 3. The taper attachment, Fig. 2, was then placed on the blank and the holes *R'* laid out, drilled and counterbored so we could use the same screws again. Then the blank was screwed on the cover, and the compound rest laid in and holes laid out for clamp bolts. The blank was then again taken out and holes were drilled and tapped, as shown at *D D*, Fig. 3, and the whole thing was put together again. A tool post was put in the compound rest and a rounding-over tool turned upside down in the tool post, and then all we had to do was to feed in the rounding-over tool from the back, thus finishing the nuts at one setting and saving at least two-thirds time. A READER.

* * *

SUPPORT FOR BORING MILL TABLE.

During a recent visit to the shops of Mackintosh, Hemphill & Co., Pittsburg, Pa., a large boring mill was noticed which had a rather unusual form of support for the table. The mill in question has an extreme capacity of 36 feet when the housings are set back to the limit, but it is rarely used on work larger than 30 feet in diameter. Some of the work bored and turned on it is very heavy. A heavy stepped nickel-steel gear for a rolling mill was on the table at the time of



Support for Boring Mill Table.

our call which weighed about 30 tons, and work much heavier than this is often carried. One instance was quoted where two flywheels, each weighing 90 tons and 30 feet in diameter, were turned. As the mill is of a pattern much lighter than would now be built for an equal capacity, it is not strange that the supports provided for the table for comparatively light work have been found inadequate for heavy work, and something more durable substituted. At present the table is supported by eight slippers, such as shown in the cut. The socket *A* is bolted to the periphery of the table, which carries the slipper *C* in which is mounted a wooden block *E*. Between the wooden block and the track *G* there is interposed a piece of fiber for a sole. The adjustment of each of the shoes is made by the key *B*, which is held by the setscrew *D*. The arrangement is said to be satisfactory, which is saying a good deal, considering the severe tests to which it has been put.

* * *

Warren E. Willis, Harrisburg, Pa., writes us that he has working drawings of the devices for relieving milling cutters described in the October number of MACHINERY. These devices are applicable to any engine lathe, and prints of the drawings can be furnished to any desiring them. In his article on Cellulose Machines, published in the September, 1901, issue, Mr. Willis tells us that he inadvertently omitted to mention that the credit of the invention of this machine should be given to Mr. George R. Sherwood, of Kearney, Neb.

* * *

Experiments made to determine the loss ensuing by exposing coal to the weather, unprotected in any way, show, contrary to general belief, that it is very small. There was a gain in the amount of oxygen but a loss of carbon, hydrogen and nitrogen; the loss of calorific power was slight.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

Fay & Scott, Dexter, Me., are remodeling their line of engine lathes, their 32-inch lathe being so far the last one changed over. The bed has been made deeper and heavier and is mounted on cabinet legs of neat design. The headstock has been strengthened and improved by a larger spindle and larger bearings. The new carriage is made very wide, is provided with generous bearing surface on the V's and is strongly reinforced in the waist. The tailstock is provided with a pinion for moving it easily along the bed. The center rest has also been redesigned to be a fitting accompaniment to the remainder of the machine.

The two-spindle drill built by the Geo. Burnham Company, Worcester, Mass., described in the June, 1901, issue, is now made of the same design with from five to ten spindles, as may be required. This tool is a sensitive drill with independent drive for each spindle and is provided with automatic feed for each, if desired. The feature of the tool is that no quarter-twist bolts are used, the belting being direct between the cones. The cone spindles driving the drill spindles are all driven by one horizontal shaft through bevel gears. One gear of each pair of bevels is a fiber gear which reduces the noise to a minimum. The horizontal shaft is provided with a tight and loose pulley for the belt from the countershaft.

IMPROVED BORING MILL TABLE CHUCK.

A chuck adapted to heavy work and especially for boring machines has been designed and is being placed on the market by the D. E. Whiton Machine Company, New London, Conn. An important feature of the chuck is that the mechanism is inclosed so that dirt and chips are excluded from the working parts, which is most desirable on a vertical spindle machine. The jaws are both universal and independent in movement. The screw giving the independent

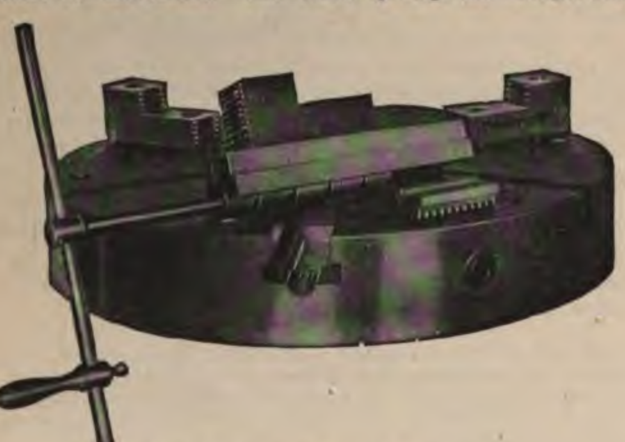


Fig. 1. Chuck for Boring Mills.

movement to the sliders, has multiple thrust shoulders (four in all), which divide the thrust and thus reduce the end wear to a minimum. The adjustable jaws are reversible on the sliders and may be clamped in any position in their length or may be removed entirely. The preferred construction of these chucks for boring mills is that of mounting them on a flange which forms an enlarged part of the machine spindle. In this manner the stiffest possible drive is acquired.

IMPROVEMENTS IN DRESES, MUELLER & CO. SIX-FOOT RADIAL DRILL.

In the May, 1901, issue one of the new line of radial drills built by Dreses, Mueller & Co., Cincinnati, Ohio, was illustrated and described. The machine shown herewith is substantially the same tool, the construction of the column and driving mechanism being unaltered, the changes being in the head. In the improved drill the spindle speeds are changed by shifting the knurled sleeve A, which may be done with the machine running. By moving the knobbed handle B up or down, the feed is disengaged or engaged. When the feed is to be thrown out automatically, the dog D is set at a point on the spindle sleeve corresponding to that at which the feed is to stop. When the desired point is reached the

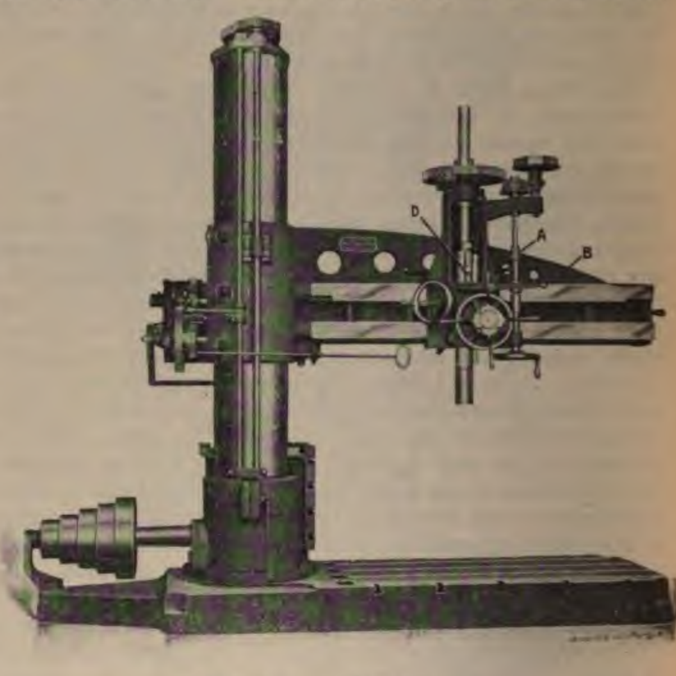


Fig. 2. Improved Radial Drills.

dog has thrown the knobbed lever upward at its outer end and has thus stopped the feed. Each of the four handles of the pilot wheel disengages the clutch between the power and hand feed, so that the spindle may be quickly returned to its upper position by the same pilot wheel. The spindle is counterbalanced by a guided weight and the head is moved on the radial arm by a spiral pinion.

HAND BORE KEYSEATER.

The machine shown in the illustration is a hand bore keyseater made by John T. Burr & Son, Kent Avenue and South Sixth Street, Brooklyn, N. Y. It is designed for cutting straight and taper keyseats in pulley hubs up to 1½ inches wide and 12 inches long. The machine, which, as its name implies, is designed for hand power, is mounted on a

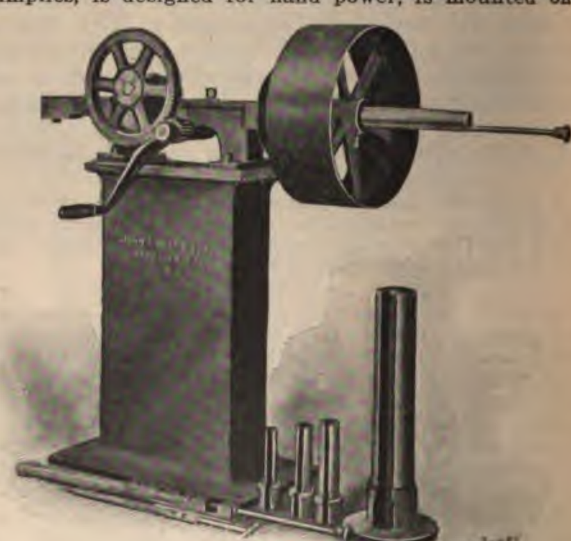


Fig. 3. Hand Bore Keyseater.

pedestal for ordinary work. For heavy work it is removed from the pedestal and directly attached to the piece to be keyseated. Since the machine is chucked to the bore and not to the face of the hubs, the latter need not be faced. The work is mounted on the mandrels shown in the cut, which have grooves cut longitudinally for the reciprocating cutter bar. The cutter is thus backed up in the most rigid

rack at the back of the machine the lever is free to move up or down with the sliding block or idlers. It can then be almost instantly pushed into engagement with the hooked rack and pressed down to get the desired tension on the belt, and the small pawl then pressed into the side rack to secure the lever in position.

For releasing the lever, when it is desired to change the position of the cutter spindle, the lever *E* is pressed down till the pawl can be released and the lever then pulled out of engagement with the rack at back.

The cutter head is provided with back gears, and the arrangement of the parts and the method of driving are such that speeds varying from 30 revolutions of the cutter spindle for heavy work, to 1,500 or 2,000 for light cuts, with small diameters of cutters, are obtained. The spindle is hollow, and has a draw-in spindle for holding milling cutters or spring collets, this arrangement doing away with the necessity for driving taper collets in or out of the spindle. The fact that the cutter head is on a slide which moves out or in makes it possible to use the cutter inserted in the end of the spindle and close to the point of support for nearly all work. In case, however, an outer support should be desired where an unusually long cutter is used or where for any reason it might be desirable to employ an arbor, there is an overhanging arm provided, as in Fig. 2. Fig. 3 shows the cutter head at an angle, and this feature of the machine which enables the head to be set at any desired angle enables a large class of work to be done with a common end and side mill, which would ordinarily require an angle mill.

The machine is solidly built, weighing 1,900 pounds, and is known as the No. 1 Van Norman duplex milling machine. The movement of the slides is as follows: Longitudinal feed of table, 22 inches; cróssfeed in and out from the column, 8½ inches; vertical movement, 19 inches; movement of ram, 9 inches. The company are preparing full universal centers for all kinds of index milling, spiral cuttings, etc., these parts being constructed so they can be operated on the regular machines without swiveling the saddles of the machine.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

The following inquiries have been received from different readers, and as they can undoubtedly be answered more fully by those who have special experience in these various lines of work than we could answer ourselves, we will submit them to our readers and trust that those who can do so will give the desired information. The questions are as follows:

F. F. K.: How are the teeth in hack-saw blades made?

J. H. C. (England): Please give me directions or a receipt for hardening twist drills. We have our own method for doing this but unfortunately find that sometimes the drills will not stand up to their work.

W. W. U.: How can I rig up an engine lathe to cut a groove in a cylindrical cam. It is to be a regular motion cam with the groove turned on the surface of a cylinder. The groove must be square with the surface, or, in other words, the same as a square thread; but it must be right-handed half way around, and left-handed on the other half of the cylinder—the pitch being 1¼ inch. I would like to be able to make a fixture to go on the lathe, without a great deal of expense.

C. L.: Please inform me how I can turn up circular-forming cutters from ½ inch to 1¼ inch face and get a smooth surface. I make my master tools very carefully but have some difficulty in getting them to cut. They will cut all right for a while and then refuse to cut, simply burnishing the steel. I use good lard oil, but still am not successful. The cutters are 2 inches in diameter and have a ½-inch hole with left-hand thread.

[If the machine is not stiff enough to hold the cutting tool up to its work there is likely to be trouble such as you outline. Also if the steel used in the cutter is not suitable the edge may wear off, destroying the clearance. As you have doubtless looked out for these features we would like to have our readers give their experience. We will also refer you to Mr. Woodworth's article on the first page of this number, in which an effective type of forming tool is described, and to page 38 of the October, 1900, number of MACHINERY, which contains a little information about the subject.—EDITOR.]

10. A. E.: I am making a steel T-square, using band steel for the blade, which is 2½ inches wide and 3 feet long. I would like to know how to bronze it to prevent rusting. Will it be necessary to grind and finish the faces before bronzing?

A.—A rust-resisting black bronze is said to be produced by a mixture of potassium sulphide, 1 part; ferric chloride, 10 parts; and water, 200 parts. The article to be bronzed is dipped in the solution and dried as many times as may be necessary to produce the color and depth of bronzing desired. The blade may be given a lustrous black color which will resist rust to quite a degree by immersing it in a hot mixture of 1 part black oxide of manganese and 10 parts saltpeter. In either case the blade should be brightly finished and perfectly free from grease or the perspiration of the hands. A patented process for making steel and iron rust-resisting consists essentially in heating the parts to a red-hot temperature in the presence of steam. The result is a blue-black surface that resists rust to a most remarkable degree.

11. O. G. M.: I would like to know how cold-rolled steel is blued such as that from which buttons are made. Is it done by acids?

A.—We are not familiar with the work to which you refer, so cannot say how the buttons are blued. In general, however, small steel and iron pieces are blued by heating them in sand, wood ashes, or powdered charcoal. An iron vessel is used to hold the articles and is heated over an open fire. The mixture of sand and pieces to be blued is stirred until the desired color is obtained. Sand gives a light blue and charcoal a dark blue. It is probable that the buttons to which you refer are treated in some way which will make them rust-proof, which is not a characteristic or ordinary bluing, although articles thus treated do not rust so readily as when left bright. Read answer to Question 10.

12. A. D. M.: When tempering steel after hardening is it better to draw the temper by dipping in linseed oil and drawing over the fire, or by placing the articles on a piece of hot iron?

A.—Articles of thin material, like springs, which require a spring temper, are frequently treated by dipping in oil and then burning off the oil over a fire. Blacksmiths adopt this method instead of trying to temper by watching the color, as it is found that it subjects the piece to just about enough heat to produce the desired results. In the case of thicker pieces, however, like tools, it is much better to use the hot iron and watch the color. The temper can thus be drawn to just the point desired and the steel will be tempered more uniformly both on the outside and inside than when the other method is used.

13. F. A. R.: According to the formulas for calculating the power of belting the arc of contact is taken as a factor, and in the case of a belt running over a very large pulley and a very small one—say, 48 inches and 8 inches respectively—the supposition is that the larger pulley will hold the belt while it slipped on the smaller one. In practice, however, I find this to be different. In nearly all cases the belt seems to slip on the larger pulley. Why is this?

A.—It is possible that in the cases that you have observed the surfaces of the smaller pulleys have been rougher than those of the larger pulleys, or have been of different material. Our experience is that the belt will ordinarily slip on the smaller pulley. This is certainly the case on the driving cones of machine tools, and if it were not the case the remedy for a slipping belt would naturally be to adopt smaller instead of larger pulleys, which manifestly is contrary to experience. It is well known, moreover, that increasing the arc of contact by a binder pulley tends to prevent slipping, which is also contrary to the instances that you have observed.

* * *

The first issue of the American Blacksmith, published at Buffalo, N. Y., has been received. It is a practical publication for blacksmiths and is well worthy of their support.

5. Ample weight, or rather mass, so as to absorb vibrations and permit accurate and nicely finished work to be done.

In Fig. 7 is the machine assembled, showing an auxiliary table attachment provided with a longitudinal lever movement, and a transverse screw adjustment.

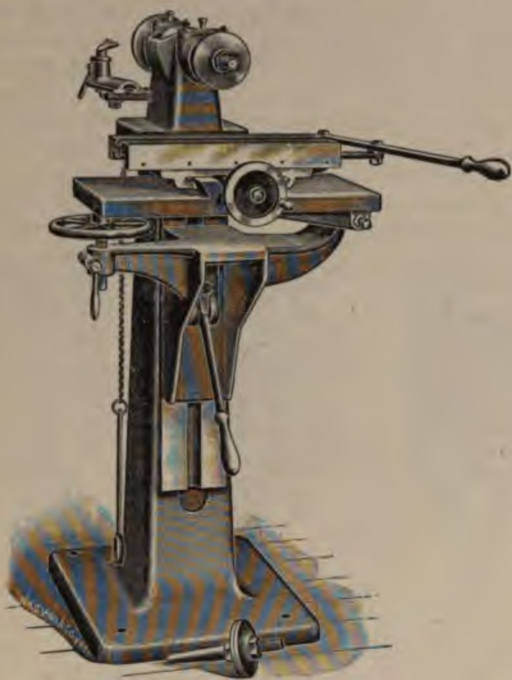


Fig. 7. Small Surface Grinder.

Fig. 8 gives a section through the head, and, together with Fig. 9, shows how requirements one, two and four were fulfilled. The bearings are babbitted and have oiling rings. The front bearing is tapered to compensate for wear and the thrust adjustment is accomplished in an unusual way.

It was desired to have a minimum overhang, so the nut

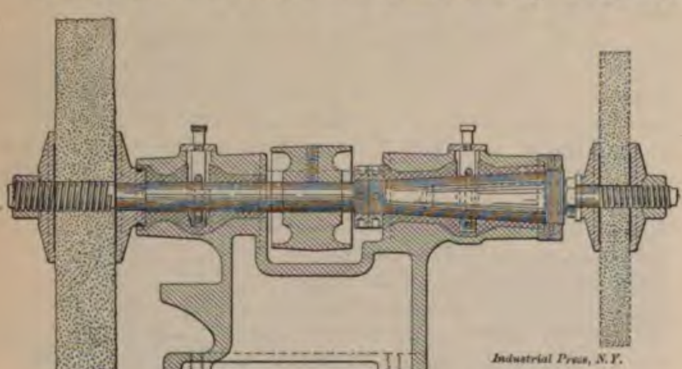


Fig. 8. Section through Head.

and collar were therefore made quite thin. The nut has eight radial keyways, one of which fits over a radial key on the collar, and this key also extends inwardly into a keyway in the spindle. The nut is thus positively prevented from turning and does not depend upon friction.

Fig. 9. Spindle and Thrust Bearing.

Requirement two is met by mounting the emery wheels on small arbors having taper shanks fitting into a taper socket in the spindle. Requirement three is met by having the knee counterbalanced by a weight within the column, by using a quick-acting cam clamp, and by having the fine adjustment made by a screw and large handwheel.

ELECTRICALLY-DRIVEN YANKEE DRILL GRINDER.

The Wilmarth & Morman Co., Grand Rapids, Mich. have brought out an electrically-driven model of the Yankee drill grinder which is adapted to wet grinding. The motor is mounted on the same spindle with the grinding wheel, so the connection is direct without belting and is inclosed in a dust-proof case. It is compound-wound and its starting-box is conveniently located in the column of the machine. The grinding wheel is supplied with water by a centrifugal pump and the whole grinding face is flooded with water so that there is little possibility of drawing the temper of a drill with ordinary care, even when grinding heavily. The water from the wheel hood is returned to the tank by a rubber pipe. The tank has a settling space into which the grind-

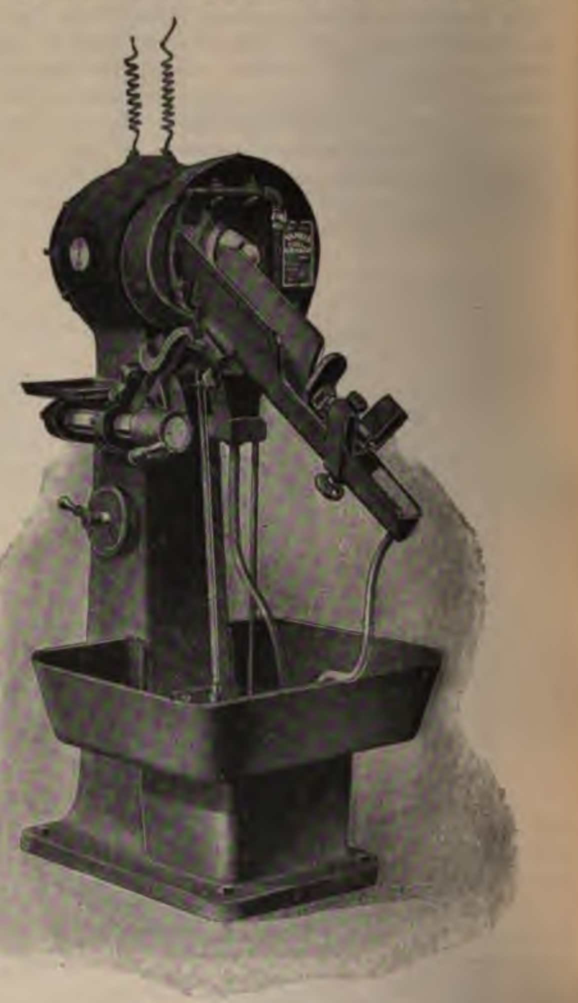


Fig. 10. Electrically Driven Grinder.

ing debris settles before the water is again drawn into the pump. The bearings are protected from wet and grit so that the life of the machine should be as long as a dry grinder with the advantage of doing better and faster work. The machine has a capacity for twist drills from ¼ inch to 3¼ inches and weighs complete about 500 pounds. The small amount of water which trickles down the bottom of the Vee is also returned to the tank by a rubber pipe attached to the lower end.

OSTER PIPE MACHINE.

The pipe machine, Figs. 11 and 12, is designed for cutting and threading 1-inch and 6-inch pipe. It is set on a heavy base which is of such a height that the center of the pipe comes about 30 inches from the floor. This height makes the handling of the larger sizes of pipe easier than if either higher or lower. The base carries an oil tank from which the oil is pumped on to the dies or cutting-off tool when in use. The oil tank is provided with a drainage cock for convenience in cleaning. The vise holding the pipe is of original design, the object being to clamp the pipe without great effort on the part of the operator and to center the pipe absolutely accurate with the dies in order to insure perfect threading. The vise carrying the pipe is fed forward to the dies by a rack and pinion driven by a handwheel. The die head is of the Oster standard form, the dies being removable outwardly through the head, which makes changing for

nt sizes or for blank dies when cutting off, convenient. utting-off tool is operated by a star-wheel mounted on e head. By this arrangement a smooth and powerful is obtained which enables the pipe to be cut off rapidly

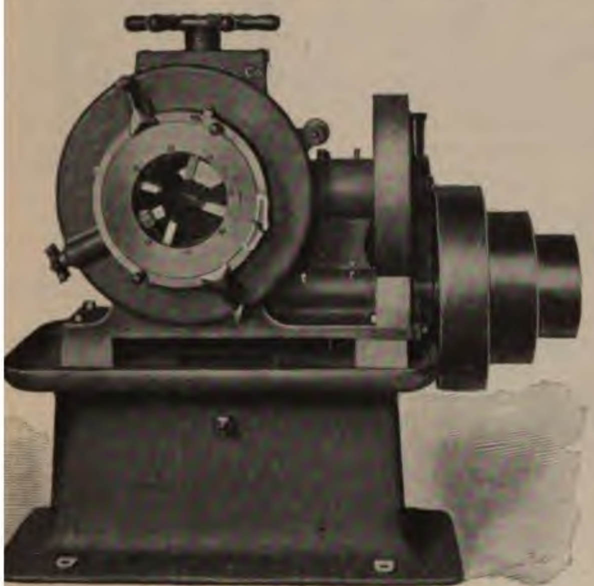


Fig. 11. Front of Pipe Machine.

ith an entire absence of burr, and without destructive on the cutting tool. The gearing is entirely inclosed, g the tool a safe one for general use. The total weight machine is 1,300 pounds.

NEW WORCESTER DRILL GRINDER.

Washburn shops of the Worcester Polytechnic Insti- Worcester, Mass., exhibited at the Pan-American Exposi- new model of their drill grinder which is peculiarly d to wet grinding. As shown in the cut of the wet

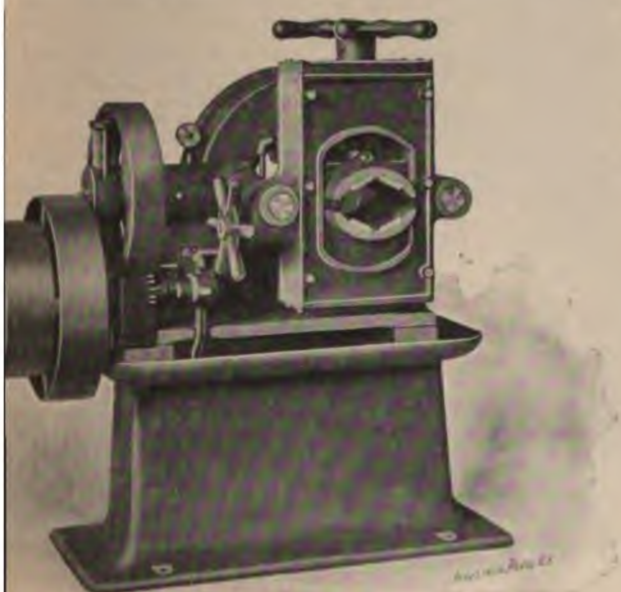


Fig. 12. Rear of Pipe Machine.

r, the drill holder is inclined to the face of the grinding so that the shank of the drill is higher than its point. d of applying water to the wheel it is applied to the tself, from whence it runs to the face of the wheel. ater floods the drill point before acquiring the velocity revolving wheel, consequently has much more cooling than when spattered on the drill point from the wheel usual manner. As the water acquires the velocity of eel it is thrown by centrifugal force into a reservoir d to the upper part of the wheel case, from whence it flows down onto the drill. In this way the use of a with its attendant troubles, is avoided.

The drill holder correctly holds drills from ¼ inch to 2¼ inches in diameter without making any preliminary adjustment whatever. Any drill between the limits of diameter mentioned may be laid in the holder without adjusting it to the diameter or length. A new form of lip rest automatically determines the exact position of the drill point relative to the grinding wheel, irrespective of the drill's diameter or length. A foot stop is provided for grinding flat and irregularly-shaped drills.

The same model is made for dry grinding and driven by an air motor placed in the base of the machine. When the machine is thus driven, advantage is taken of the exhaust from the motor for cooling the drill points. A bench size of the dry grinding machine in the new model is also built, which is adapted to drills ranging from ½ inch in diameter down to the smallest in use. This model also holds the drills automatically in the drill holder, the same as in the larger sizes. The holder is also provided with the micrometer feed for advancing the drill holder to the face of the grinding wheel.

Fig. 13. Wet Drill Grinder.

THE FARWELL DRILL GRINDER.

The efficiency of a milling cutter depends on the sharpness of its teeth. To make each tooth do its full share of the work, it must not only be sharp, but all must be of the same radial distance from the center. The surest manner of getting this condition is to grind the cutters on the work arbor. For grinding milling cutters in working position the Adams Company, Dubuque, Iowa, make a cutter grinder which is particularly adapted to grinding the cutters of the Farwell

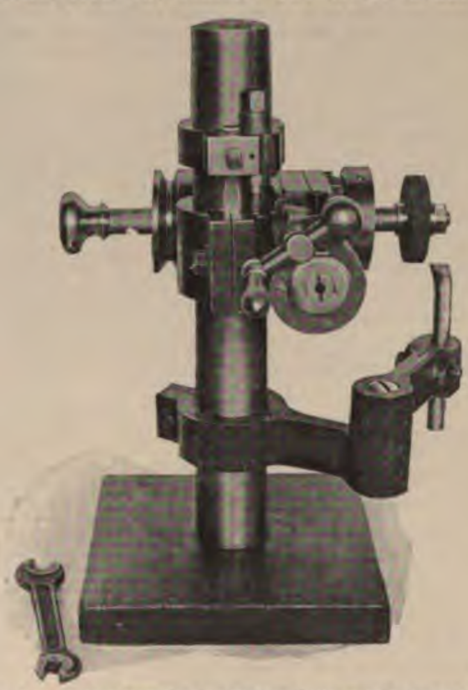


Fig. 14. Cutter Grinder for Planer Milling Attachment.

milling machine for iron planers, made by them. The grinder has a base which is clamped to the table of the machine. The wheel is driven by a round belt either from the milling countershaft, or, preferably, from a separate countershaft. The grinding wheel may be swiveled to grind the sides and face of any straight tooth cutter without removing the cutter from the spindle. The grinder spindle takes ¾ x 6-inch wheels with ½-inch hole. It has an end adjustment by hand of 2 inches and by screw of 1½ inches. The total weight of the grinder is 60 pounds.

* * *

"A rolling stone gathers no moss" may be a safe motto for some people to heed, but the mechanic who never bestirs himself from one shop, is quite certain to gather more "moss" than experience as was aptly put by a writer in MACHINERY some years ago. A Basuto saying is the converse of the old proverb quoted, being "A sitting hen never gets fat." There is nothing like getting into a new atmosphere to sharpen the wits and awaken self-reliance. If a man has the stuff in him, it will come to the surface and he will be the better for occasional changes from shop to shop as he will add to his store of shop lore in each place. If, however, he is not of a progressive nature, he had better stay in one place, since roving will only be likely to cause him to develop into a tramp.

* * *

FRESH FROM THE PRESS.

MECHANICAL DRAWING. By F. W. Bartlett, lieutenant-commander, U. S. N. Published by John Wiley & Sons, New York. 188 8vo pages; illustrated. Price $3.

There are so many textbooks upon mechanical drawing that there hardly seems to be need for another one. What is perhaps a reasonable excuse in this case, however, is that this book is written for the use of naval cadets at the U. S. Naval Academy, and so covers the standard methods used by the Navy Department in so far as is possible in a textbook. The drawings referred to for the general instruction are those of the Bureau of Steam Engineering of the Navy Department, and the methods of that bureau have been followed. The book does not go deeply into descriptive geometry. It treats on the use of the instruments, lettering, the various conventionalities of working drawings, and gives directions for drawing the practice sheets required in the course. There are directions for freehand sketching, and there is a chapter upon working drawings in which some of the more practical features are considered. The book is a thoroughly practical treatise on working drawings and will be preferred by many because of the standard methods taught.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

THE FRANKLIN MACHINE WORKS, Philadelphia, Pa. Illustrated catalogue of horizontal boring machines, milling machines and cold saw cutting-off machines.

THE KEYSTONE DROP FORGE WORKS, Philadelphia, Pa. Circular of a safety shackle hook for use on cranes, etc., which does away with accidents from slipping or breaking of the hook.

THE STOW FLEXIBLE SHAFT CO., Philadelphia, Pa. Illustrated circular of electric portable drills and various other portable tools for drilling, tapping, grinding, etc.

THE FRANKLIN PORTABLE CRANE & HOIST CO., Franklin, Pa. Circular of small portable crane designed to be transported to any part of the shop, for handling castings of small and medium size.

THE PATTERSON TOOL & SUPPLY CO., Dayton, O., are now building their "Challenge" power hack saw so that it will handle 12-inch I-beams and channels. They are also selling a 4-inch machine.

WILLIAM G. LE COUNT, South Norwalk, Conn. Price list of machinists' tools, which include lathe dogs, clamps of various styles, expanding mandrels, adjustable blocking and jack screws for use on the planer, drill press, etc.

THE E. W. BLISS CO., Brooklyn, N. Y. Catalogue of drawing presses and spinning lathes. The largest of these is the Bliss toggle-joint press, which is for the heaviest class of drawn sheet metal work. A great many intermediate and small size presses are also shown.

THE THURSTON MFG. CO., Providence, R. I. Illustrated circular of special machines for jewelers' and diemakers' use. These include an inverted milling machine for blanking and trimming dies, a filing machine for work done upon dies, a price list of metal saws, milling cutters, etc

A. L. HENDERER'S SONS, Wilmington, Del. Catalogue of hydraulic jacks and boilermakers' specialties, such as tube expanders, steel screw punches, hydraulic punches, hydraulic jacks and pressure pumps. Also a circular of malleable iron pipe vises.

THE WASHBURN SHOPS, Worcester, Mass. Supplementary catalogue of the Worcester drill grinders, in which are illustrated a few of the more recent machines, including the wet grinders. At the back of the catalogue is a complete tabulated list of their full line of machines.

FOOTE, BURT & CO., Cleveland, O. Illustrated catalogue of multiple spindle drills. Several new types of these machines have been brought out recently. Of these may be mentioned a new universally adjustable automatic multiple spindle drill, as representing one of the latest designs for manufacturing purposes.

THE PRENTICE BROS. CO., Worcester, Mass. A neatly illustrated pamphlet entitled "Our Shops and Some of the Products." This booklet contains no descriptive matter but a good idea of the extent of the works and the variety and character of the drills and lathes manufactured can be obtained from the illustrations. There is a view of their Pan-American exhibit and nearly all of the machines illustrated are electrically driven.

THE B. F. STURTEVANT CO., Boston, Mass. Catalogue No. 117 of the Sturtevant electric motors, generators, and generating sets. In the introduction it is stated that this company have patents for over 100 sizes and types of engines and that their motor and generator designs are made in correspondingly great variety. The catalogue is in the usually attractive style of those issued by this company. We have also received catalogue No. 118 of the steam and hot blast heating drying apparatus.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York. Catal of tool outfits for home use. This is one of the most attractive logues recently issued. In it are listed a large number of outfit tools intended for those who wish to have a good assortment of at hand for such work as is ordinarily done about the house. T outfits cost from $5 to $85 each, the more expensive ones inclu a work bench and cabinet. Even the cheapest outfits, however, contained in a case where the tools can be kept together.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass. H book of the technical correspondence courses in electrical, mechan stationary, marine and locomotive engineering; textile work; and ing, ventilating and plumbing. This gives complete information the school, its instructors, the courses of instruction and the met followed by the instructing staff in correcting papers and other assisting the students. There are also sample pages of the pa The list of subjects for each course is given in full.

THE KEMPSMITH MFG. CO., Milwaukee, Wis. Catalogue of zontal milling machines. There are five types or sizes of plain mil machines shown, and four universal millers. These are mostly of knee type, but there is one—a plain miller—of the Lincoln type. are all of new and improved design and there are several attachm such as for vertical and circular milling. The cuts, make-up press work of the catalogue are such as to make a bit of trade li ture that will attract attention.

THE PRATT & WHITNEY CO., Hartford, Conn. Catalogue of tools, standards and gages. This is virtually a new catalogue cover to cover, all the cuts being new half-tone engravings of the quality. The previous catalogues of this company have been consid by machinists as standard reference books, in view of the prac information contained, and this new catalogue is destined to be more valuable in this respect. It contains descriptions of a nu of new tools brought out during the past year, and is a catalogue all machinists will appreciate.

THE SPRINGFIELD MACHINE TOOL CO., Springfield, O. Illust catalogue of a complete line of engine lathes from 42-inch swin 14-inch swing, and of crank shapers. The lathes manufactured by company include both the well-known Springfield Muller engine l and the new Ideal lathes recently described in our columns. The ture of the new lathe is the new arrangement of the feed gear effecting feed changes easily and rapidly without removing parts by nuts and washers. Several sizes of turrets and turret lathe also shown.

MANUFACTURERS' NOTES.

THE BURT MFG. CO., Akron, O., report the receipt of two impo orders for Cross oil filters from German manufacturers.

THE LUNKENHEIMER CO., Cincinnati, have been awarded the medal for their valves, lubricators and engine-fittings, at the American Exposition.

THE CLEVELAND TWIST DRILL CO., Cleveland, O., announce they have been awarded the gold medal at the Pan-American l sition.

THE BUFFALO FORGE CO., Buffalo, N. Y., have received two medals and a silver medal for excellence of apparatus exhibit the machinery exhibit at the Pan-American Exposition.

THE W. P. DAVIS MACHINE CO., Rochester, N. Y., are abo bring out a new 36-inch and also a 42-inch triple-geared engine of massive design and thoroughly up-to-date, which they expect to ready in about three months.

MR. J. I. LYLE, M. E., who has been connected with the home of the Buffalo Forge Company for the past five years, is now ma of the New York Branch, No. 39-41 Cortlandt St.

THE L. S. STARRETT CO., Athol, Mass., announce that, for the b service of the western trade, they have opened a store at South St., Chicago, where a full stock of Starrett tools will be kept. Al. T. Fletcher is manager of this branch.

CONTENTS FOR NOVEMBER.

DOMESTIC EDITION.—ADVERTISING INDEX PAGES 19-21.

MACHINERY

VOL. 8. DECEMBER, 1901. No. 4.

PUBLICATION OFFICE 9-15 MURRAY STREET NEW YORK

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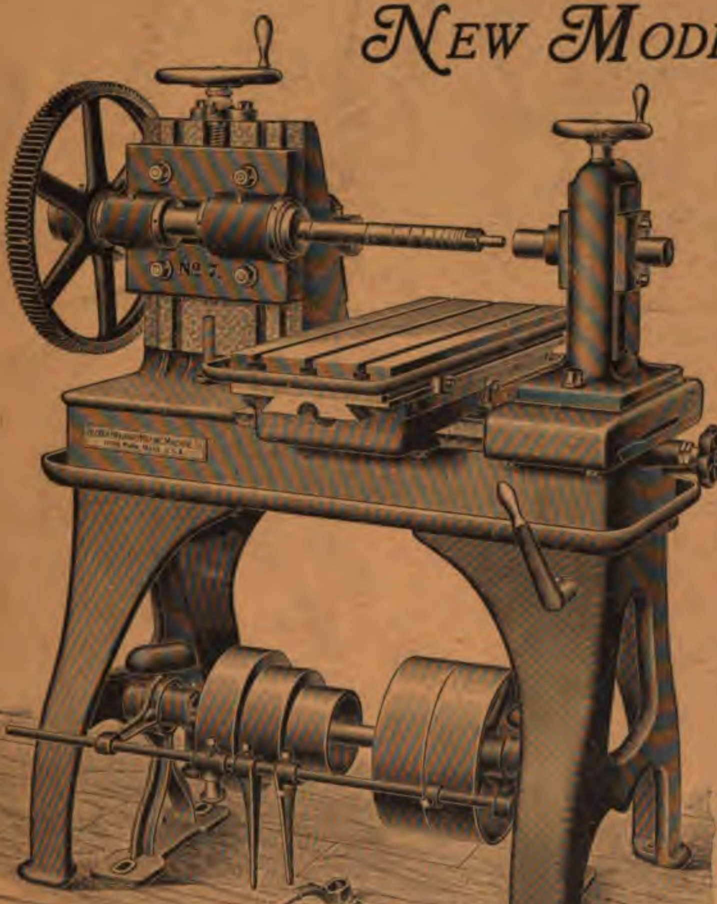

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MACHINERY.

Vol. 8. December, 1901. No. 4.

DEEP HOLE DRILLING.

A COLLECTION OF USEFUL DATA COVERING BOTH LARGE AND SMALL WORK.

GENERAL PRINCIPLES.

THE RELATION BETWEEN ORDINARY DRILLING AND DEEP HOLE DRILLING.

The process of drilling deep holes in metal is a familiar one in many shops, particularly where firearms are manufactured or heavy ordnance is constructed. Since the adoption of hollow spindles for lathes and other machine tools the methods for machining the bores of guns have been employed in machine-tool shops for drilling these spindles; and through this and other means the principles of the operation have become better understood. It is not an easy matter, however, even with the best appliances, to drill or bore a deep hole, smooth and round, of exactly the required diameter from end to end, and perfectly straight. While many mechanics are familiar in a general way with the methods and tools for doing this work, we think some specific information upon the subject will be appreciated by those who have not had actual experience in deep hole drilling.

It is well known that a long, or deep, hole—that is, one long in proportion to its diameter—is best roughed out and finished by using a tool on the end of a long bar, which enters the work from one end. This is true, whether drilling into solid metal or boring and reaming a hole that has already been drilled or bored out. A boring bar which extends through the piece and on which is either a stationary or a traveling head is not satisfactory for very long work, owing to the spring and deflection of the bar, which is made worse by the fact that the bar must be enough smaller than the bore to allow room for the cutter head. While a long hole may sometimes be finished satisfactorily by means of such a boring bar, by packing the cutter head with wooden blocks which just fill the part of the bore that has been machined, and so support the bar, the method is fundamentally wrong for long work.

The best methods for machining deep holes are nothing more nor less than an adaptation of what has been found successful in ordinary drilling and boring by means of the engine lathe or chucking machine. We will therefore discuss certain types of chucking tools and drills, and show their relationship to tools that may be used for deep hole drilling. To complete the subject there are then published two articles by contributors, one of which explains the methods developed by the Pratt & Whitney Co., Hartford, Conn., for drilling gun barrels, and the other the tools used in boring and reaming the bores of large guns.

The Flat Drill.

To start with first principles, take the ordinary flat drill. It is useful for rough work or in drilling hard metals, because it can be easily made and tempered; but it has the faculty for drilling holes that are neither round nor straight, and whose diameter seems to bear no relation to the diameter of the drill. When a flat drill runs into a blow hole or strikes a hard spot, it is deflected, as in Fig. 1, the only resistance to this deflection being the narrow edges of the drill. Under such conditions the hole will be out of round and crooked.

Add to this natural tendency of a flat drill to run out, the fact that such drills are often carelessly made, and one understands why they have the reputation for poor work. Thus, if the point is not in line with the axis of the drill, and if the lips are of unequal length or do not make equal angles with the axis, the hole will be larger than the drill diameter. This is illustrated in Fig. 2, where one lip is longer than the other and the point does not lie in the central axis of the drill. The tendency of the drill is to rotate about its point and thus the axis will move in a small circle about this point, causing the hole to be of larger diameter than the drill.

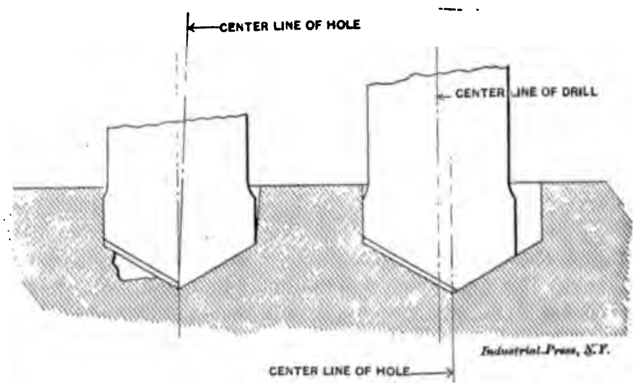


Fig. 1. Fig. 2.

It is obvious that to improve the action of a flat drill it should be so guided as to prevent its wabbling and to compel it to move forward in a straight line. This is partially accomplished with the flat chucking drill, which is a near relative of the ordinary flat drill, differing from it in that it is generally more carefully made and is adapted for use in the engine lathe. In Fig. 3 is a sketch of a chucking drill at work on a piece in the lathe, and to make the comparison fair it is shown with one lip longer than the other, as was the flat drill in Fig. 2. The work is held in the lathe chuck and turns with the spindle. A rest steadies the drill at a point near the work and in starting the hole the drill is held firmly against the rest by means of a monkey wrench. It will be noted that while a poorly ground chucking drill will make a large hole, just as does the drill in Fig. 2, if properly started it will not wabble and it will drill the hole where it is

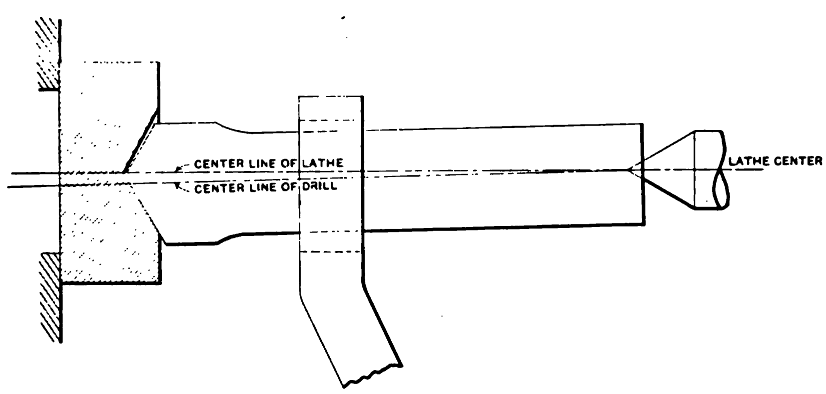


Fig 3.

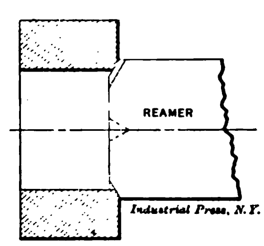


Fig. 4.

wanted and approximately in line with the lathe centers. To attain these results, however, the drill must be started right. If it is found to wabble when left free, it must be started over again, before the full size of the hole has been attained, by crowding it into the work and toward the operator at the same time, causing only one edge of the drill to do the cutting. This edge will then true up the hole and in proceeding with the drilling the trued hole will guide the drill. The latter will thus be continuously supported near its cutting edges by the cylindrical surface of the hole, and the drill will tend to advance in the direction in which it was started.

After the hole is drilled, it is usually brought to size by a flat reamer, like Fig. 4. For reasons that will be explained, the flat drill is not an accurate tool, even when well made and used in the lathe, and the flat reamer is not as reliable as one with more blades.

The general principle, however, of first starting with a true hole, and then having the drill body designed to follow in its path and so guide the cutting edges, is the fundamental principle of deep hole drilling.

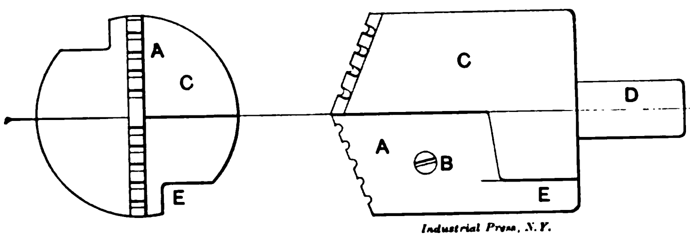


Fig. 5. Flat Drill for Deep Drilling

Fig. 5 shows how a flat drill may be adapted for deep hole drilling. The drill from which the sketch was made was employed for drilling a four-inch hole through steel rolls seven feet long and was illustrated in the June, 1899, number of MACHINERY. Instead of depending upon the narrow edges of the drill proper to guide and support the cutting edges, a blade is inserted in a cylindrical cast-iron head, the outside diameter of which is turned to a sliding fit in the hole that is being bored. The cutting edges are grooved to break up the chips, enabling them to pass out through the passage *E*, on each side of the head. The grooves are laid out so that those

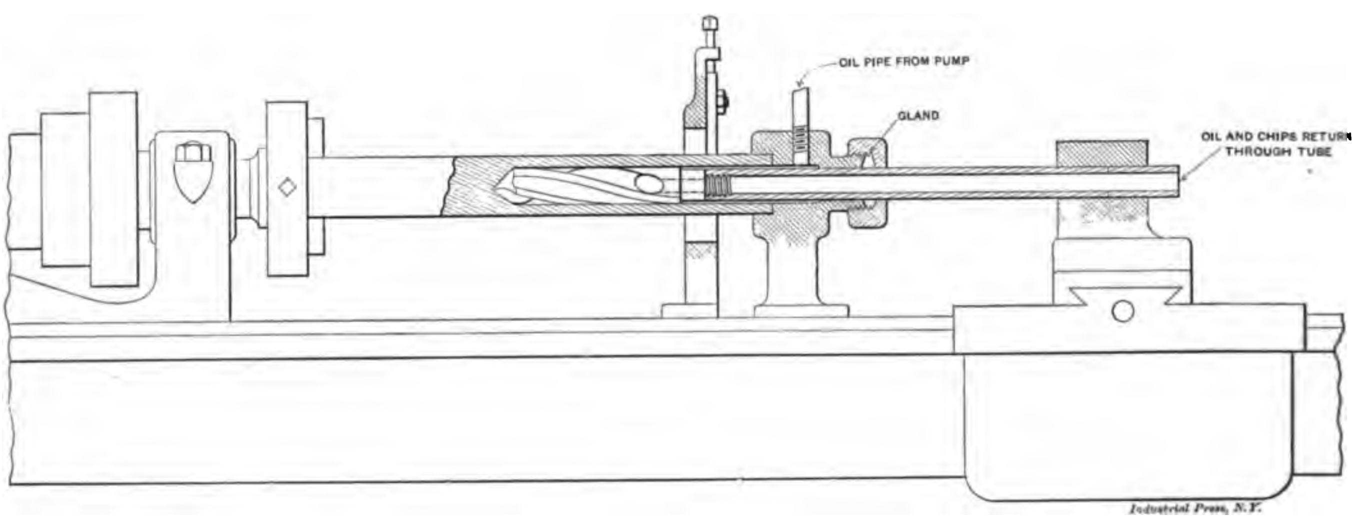


Fig. 7. Method Recommended by the Morse Twist Drill Co. for Using the Hollow Drill.

in one blade come opposite to the lands in the other blade. In the illustration, *A* is the cutter, *B* one of the screws holding the cutter to the head *C*, and the head is attached to the bar by the shank *D*.

The Twist Drill.

The modern twist drill accomplishes all that is attained by the arrangement in Fig. 5 and in addition can be ground without seriously affecting the rake and will free itself from chips more readily, owing to its spiral flutes. The lands of a twist drill present a large cylindrical surface to bear against the sides of the hole and take the side thrust. If the drill is also guided by a hardened bushing, at the point where it enters the metal, as in the case of jig work, the drill will have very little chance to deflect and the hole will be accurately located and will be quite true and straight.

The twist drill in modified form is also employed for deep hole drilling. The hollow drill, shown in Fig. 6, and introduced by the Morse Twist Drill Co., New Bedford, Mass., is adapted for this purpose, and in Fig. 7 is the arrangement recommended by this company for feeding the drill into the work. The drill has a hole lengthwise through the shank, connecting with the grooves in the drill. The shank can be threaded and fitted to a metal tube which acts as a boring bar and through which the chips and oil may pass from the point of the drill. Oil is conveyed to the point on the outside of the tube, as shown in Fig. 7.

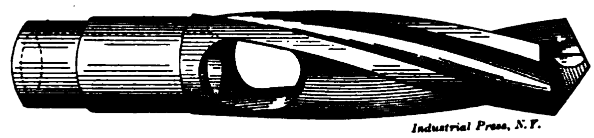


Fig. 6. Hollow Twist Drill for Deep Drilling.

In using the hollow drill the hole is first started by means of a short drill of the size of hole desired and drilled to a depth equal to the length of the hollow drill to be employed. The body of the hollow drill acts as a stuffing, compelling the oil to follow the grooves, and the chips to flow out through the hollow shank. The methods of supporting and driving the work, and of feeding the drill, are clearly shown in Fig. 7. Drills of this type are regularly manufactured in sizes up to three inches in diameter and in the catalogue of the Morse Twist Drill Co. it is stated that the best results are obtained when drilling crucible steel by revolving the drill 20 feet per minute, with a feed of .0025 inch per revolution, while machinery steel will admit of a speed of 40 feet per minute and a feed of .0035 inch per revolution.

Number of Cutting Edges Desirable.

When drilling a hole out of solid stock, some type of drill having two lips or cutting edges is usually the most feasible, and probably nothing will be devised that on the whole surpasses the twist drill for such work. An end mill, like that in Fig. 10, can be used for drilling, if it has a "center cut," and it will presently be explained how a tool with a single cutting edge may be advantageously employed, particularly for deep hole drilling. The familiar D-drill is of this type, and also its modification as used by Pratt & Whitney, in drilling gun barrels.

When it comes to trueing up or enlarging a hole previously drilled or bored, the two-lip drill is not suitable in any of its forms. For boring a true hole nothing can surpass a single-pointed boring tool, the ideal condition for finishing a hole being when the cutting point is a real diamond, or a rotating wheel of abrasive material.

It is obvious that when a hard or soft spot is encountered in boring with a tool having a single cutting edge, only that particular place is affected by the spring of the tool; while with a double cutter, as shown in Fig. 8, first sketch, any

deflection due to irregularities, such as at *a* or *b*, will cause the tool to spring and the cutting edge on the opposite side to introduce similar irregularities in the opposite side of the hole. This is one objection to the two-lip drill for accurate work.

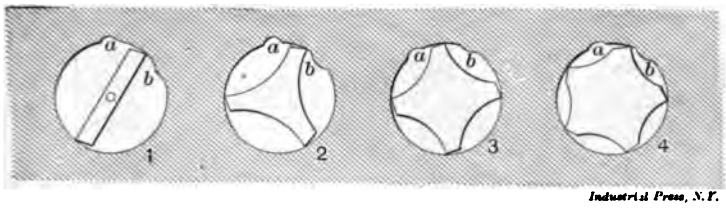


Fig. 8

With three points the tool is somewhat better supported when a high place is encountered, as at *b*, Fig. 8, and when a cutting point strikes a low place the other two edges are not moved away from their positions so much as if they were opposite the first edge. Hence a tool with three edges should prove better than one with two, and one with four, being better supported, is better on this account than one with three, but has the disadvantage of opposite cutters. Five edges ought to give better results yet.

Fig. 9. Four-lip Drill for Trueing a Rough Hole.

In Fig. 9 is a sketch of a four-grooved chucking drill which is suitable for trueing up either a drilled hole or a cored hole, but obviously it cannot be used for drilling out solid stock. It has less tendency to "run" than a two-lip drill and the edges are less liable to catch under the scale or in breaking through, since each has only half the depth of cut to take.

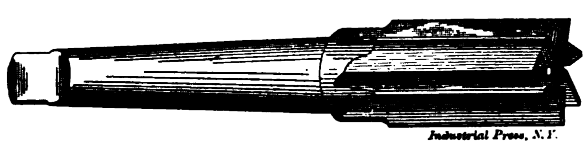


Fig. 10. End Mill, suitable for Accurate Drilling.

In general it may be said that in boring the best results are obtained when the tool has a single cutting edge, but if it is desirable to have more cutting edges, a tool with several will be more satisfactory than one with only two. Any machinist who has tried to true up the taper hole in a lathe spindle, first by boring and then by reaming, will appreciate the superiority of the boring tool over the multi-blade reamer. A reamer sometimes refuses to produce a perfectly round hole the reamer to one side. The same condition exists to a less extent with a flat or twist drill, where the cutting edges are at an angle with the center line and the resultant of any unusual pressure is felt partly as a side thrust and partly as an end thrust. Now, by making a drill to cut squarely on its end and but very little, or not at all on its sides, the side thrust is mostly done away with. The end mill shown in Fig. 10 is a good illustration of such a tool, and it is known to be capable of boring very accurate holes when used for the purpose in the milling machine.

In Fig. 11 is a boring tool, with a single cutting edge, which cuts on its end and is capable of drilling a true hole in solid metal. It was illustrated in the August, 1896, number of MACHINERY. It consists of a round, tool-steel bar, with one end flattened and ground to form a cutting edge, as shown.

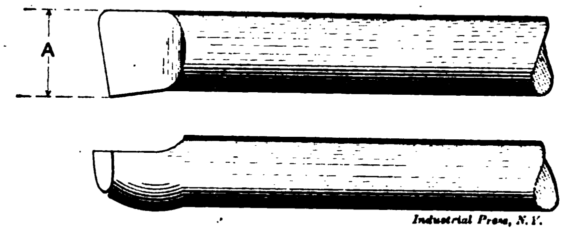


Fig. 11. Boring Tool with End Cut.

It is designed to be held in the tool post of the lathe, in a position perpendicular to the face plate. The inner edge or corner of the cutting edge should be slightly rounded to help support the cutter and prevent chattering and the width *A* of the cutting edge should be from 1-32 to 1-16 inch less than the radius of the hole to be drilled.

The objection to this tool is that it cannot be supported stiffly enough by the tool post for a hole of great depth and for this purpose the D-drill shown in Fig. 12, and which works on the same principle, is well adapted. In its simplest form it consists of a round bar of the diameter to be drilled, one-

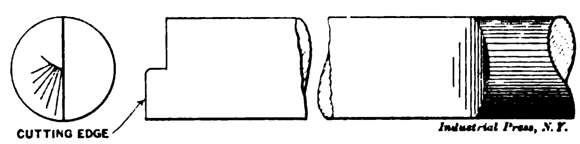


Fig. 12. D-drill used for Deep Drilling.

quarter to one-half of which is milled out to give a passage for the chips. The end of the bar is shaped with a cutting edge on one side, extending almost or quite to the center and with the other side relieved to give clearance for the cutter. Such a drill should be supported by a bearing close to the bar to be bored, in case it is to start the hole itself, and it is better yet to start the hole with a twist drill and true it up with a single-pointed boring tool and let the drill

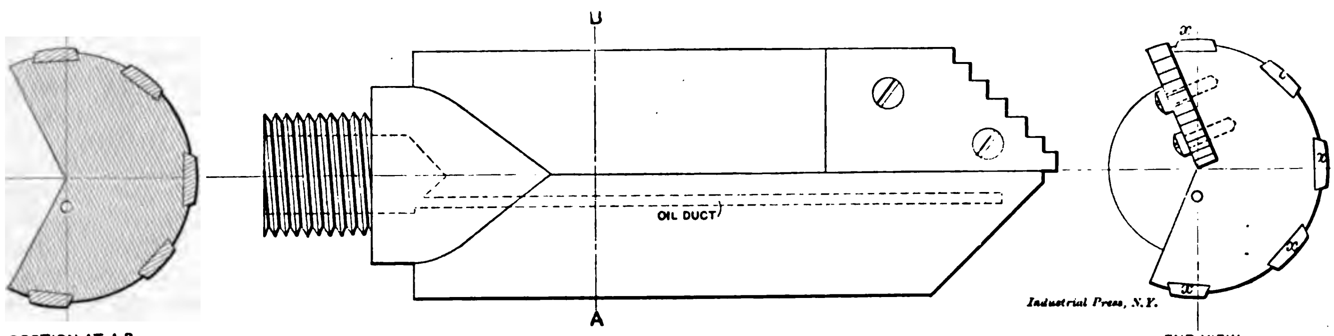


Fig. 13. D-drill with Inserted Blade, used for Deep Drilling.

and will do this whether the number of teeth is odd or even. The writer has seen the photograph of the bore of a 12-inch gun that had been reamed out with an eleven-sided reamer and the bore had eleven distinct sides, clearly visible in the photograph. The trouble was overcome by spacing the reamer teeth unequally.

Advantages of the End Cut.

One trouble with reamers, however, is that the teeth necessarily cut on their side edges instead of on their ends and the whole effect of any unevenness in the hole is to crowd

be guided by this hole. This is the surest way of getting a hole concentric with the axis of the lathe. As the bar is of the same diameter as the hole the cutter will be supported by one-half the surface of the hole, and if it is once started right in an accurate hole, it will continue in the right direction. It is desirable to have the cutter blade separate from the bar or head, as the case may be, so that it may be renewed orr emoved for grinding, particularly in drilling large holes. In Fig. 13 is a sketch of such a cutter head as used by a large ship and engine-building concern, in drilling pro-

peller shafts. The body of the cutter is made from soft steel with the tool steel strips dovetailed in and ground in place to the size. The cutters are made by jigs and are interchangeable and their shape is such as to break up the chips which are washed out by the force of oil supplied by an electric pump, through the hollow boring bar, to which this cutter head is fastened. One of these cutters, four inches in diameter, has been 12 inches in a piece of nickel steel in one hour, cutting a fair and smooth hole, and no trouble has ever occurred, even after the hole has been to a depth of 32 feet.

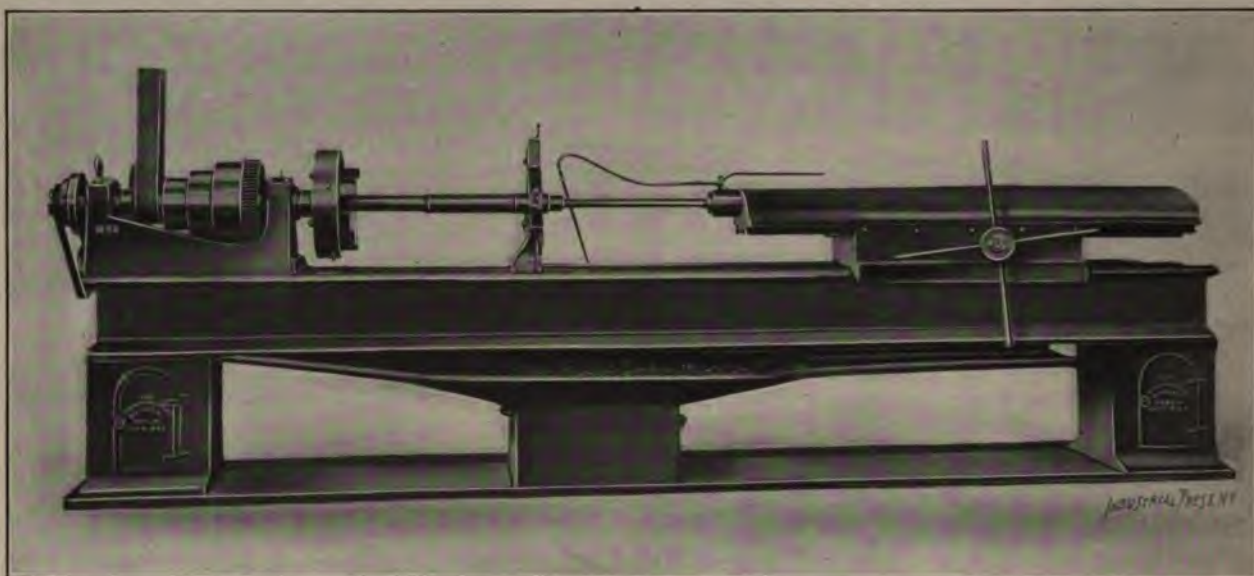


Fig. 14. Drilling Lathe Manufactured by the Lodge & Shipley Machine Tool Co.

Rotating Work vs. Rotating Drill.

In deep hole drilling it is customary to have the drill fixed so that it cannot turn, and rotate the work, following the usual method in this respect for boring accurate holes in the lathe. So far as we know this is done merely because it is the more convenient method and as good results undoubtedly could be obtained by rotating the bar and having the work stationary, provided—and this is the point—the drill were as well supported and guided in one case as in the other. We know, for example, that some of the most accurate drilling is done on the horizontal boring machine and on the milling machine, with rotary cutter and stationary work. A possible difference in the two methods is that when the work revolves the drill would encounter more rapidly moving particles of the metal, if it ran out of line, but we are not prepared to say that this would have an appreciable effect. Since the outer end of the work can be supported in the center rest it is always possible to make the work run true, while it is not so easy to make a drill run true and coincident with the axis of the work.

Drilling Lathe.

While an engine lathe may be used for deep hole drilling, supporting the work in the chuck and center rest, and supporting and feeding the bar by means of the carriage, a drilling lathe is almost a necessity where much drilling is to be done. In Fig. 14 is a neatly designed lathe for this purpose manufactured by the Lodge & Shipley Machine Tool Co., Cincinnati, O. It is essentially a turret lathe, with a bed of any desired length, but with the turret slide removed and in its place there is a long slide for carrying one end of the boring bar or drill. Such a lathe is suitable for drilling lathe spindles or any medium-sized work of a similar character. It has an oil pump to be connected with the oil tube of the boring bar, a pan to catch the chips and oil, and an oil reservoir into which the oil drains and settles, and from which it is pumped.

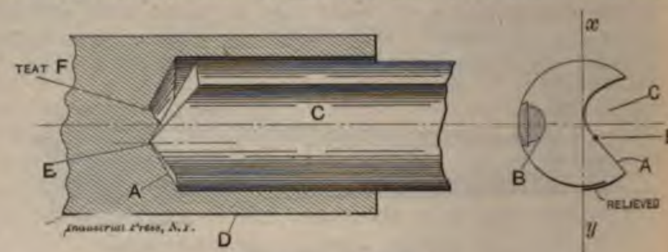
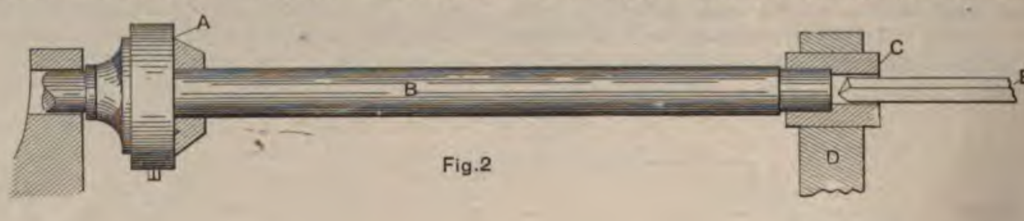


Fig. 1. Pratt & Whitney Drill.



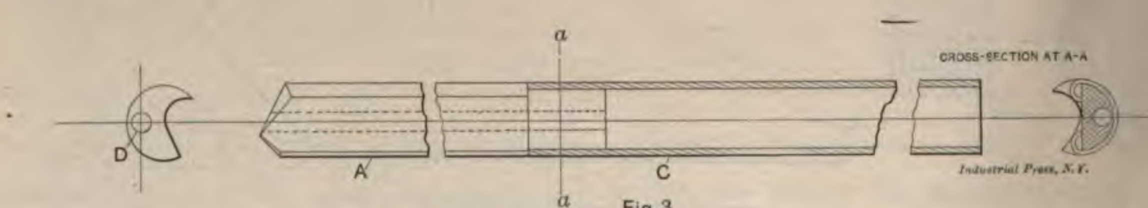


Fig. 2. Starting the Drill. Fig. 3. Drill and Long Shank.

DRILLING DEEP HOLES BY THE PRATT & WHITNEY METHOD,

CONTRIBUTED BY C. L. G.

A highly satisfactory drill for use in drilling deep holes is one brought out by the Pratt & Whitney Co., principally for use in connection with their gun-barrel drilling machines. The tool in question is a development of the old D or hog-nose drill which has one cutting lip only. It is carefully ground on the outside and is supplied with an oil duct through which oil at high pressure may be brought direct to cutting

same of the appearance of the tool we have described. These figures illustrate a drill ground on the end so as to produce several shavings.

The present practice in relieving the large drills is as per sketch in Fig. 8. The straight, or radial, edge is the cutting edge of the drill and the distance *B* is about ⅛ inch on a one-inch drill. The surface *A* is left of the full radius of the drill and makes a good back rest. When the drill is ground on its periphery it is made *very slightly* tapering toward the shank to free itself. As previously stated, in milling the chip

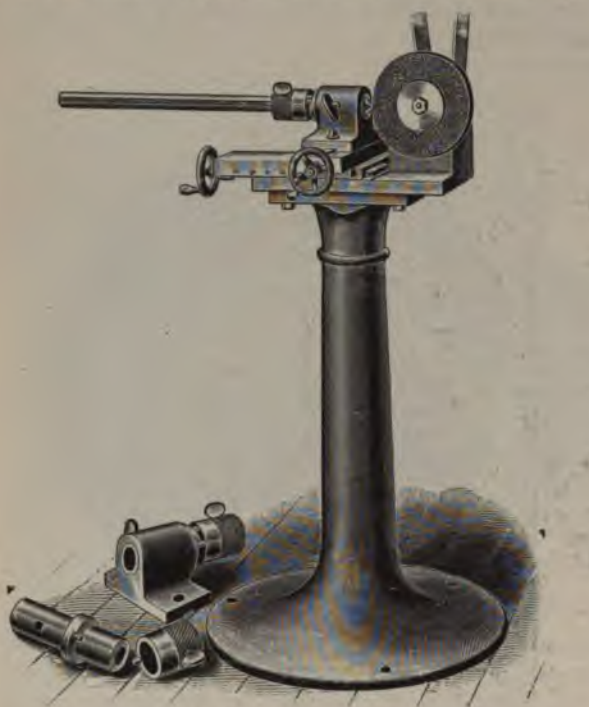


Fig. 10. Drill Grinder.

groove the cutter is brought exactly to the center of the drill. When hardening and grinding, however, the location frequently changes slightly so that the groove does not come to the center of the drill. In such cases it is necessary to grind out the lip at the point as shown in the illustrations from the photographs in Figs. 4 and 5. Generally the workman grinds this a little beyond the center, but no trouble results, as the small teat produced thereby is broken off when the bottom of the ground out place comes in contact with the end of the teat. (See sketches 6 and 7.)

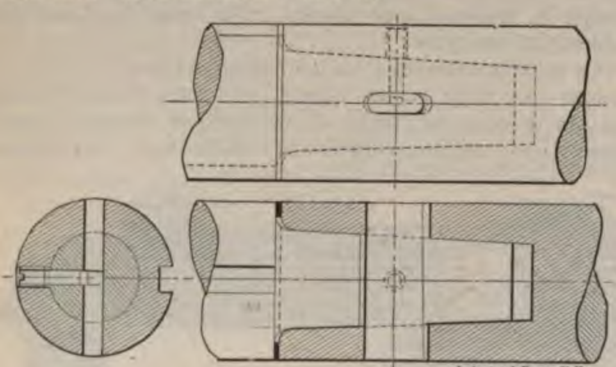


Fig. 2. Front End of Boring Bar showing Method of Attaching Boring Head.

In Fig. 9 is an engraving of one size of the gun barrel drilling machine, as built by Pratt & Whitney. The machine is double and has a horizontal bed. The heads are at the end and have mounted in them independent spindles parallel to each other. On their inner ends are chucks for securing and rotating the barrels in the adjustable rests which support, guide and control the starting of the drills, which are secured in the sliding carriages and are fed positively 38 inches by a screw having automatic stops. The screw has a variety of speeds through change gearing, to compensate for different qualities of stock to be drilled.

Two rotary pumps (one for each barrel) force oil, supplied from a tank placed underneath the machine, through a series of tubes into and through the drill. The oil lubricates the cutting lip and forces out the chips into the basin on top of the tank, where they are drained, and the strained oil returned to be pumped again.

A special grinder is employed for grinding the drills, a view of which is shown in Fig. 10. The engraving is misleading, however, since the fixture to support the drill holds the latter at an angle with the face of the wheel, instead of parallel with it, as shown. This angle is such as to give the cutting lip about the same inclination as on ordinary twist drills. The fixture for holding the drill is carried on a slide on the table of the machine. It is made to receive bushings of different diameters and the drills are held in the latter by a set screw. The bushings are free to slide and rotate in the fixture and when a drill is revolved by hand it is given a forward or backward movement through the action of a pin in its bushing, which bears on a spiral cam in the fixture. The lip of the drill thus receives the required spiral movement necessary to give it the proper clearance. When grinding a stepped drill the corner of the wheel must be used and this corner must be sharp, not rounding, so that the several cuttings will be severed from each other.

BORING LARGE GUNS.

CONTRIBUTED BY J. M. B. SCHEELE.

It is generally known among the well-informed mechanics that the introduction of built-up or hooped guns necessitated many new designs and radical changes in machine tools,

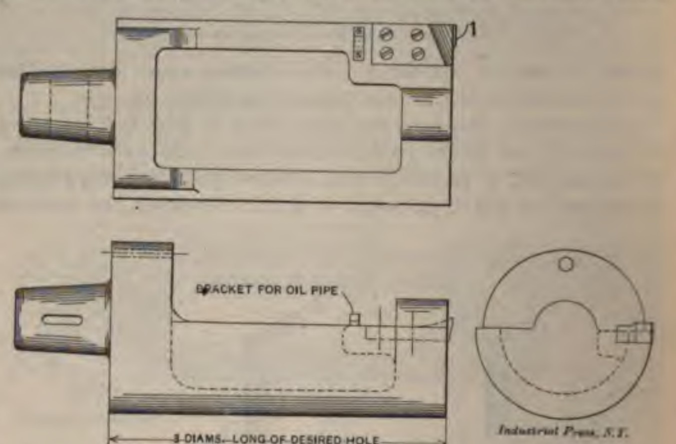


Fig. 1. Hog Nose Tool Boring Head—Cast Iron.

especially in the lathe. My intention in this article is to elucidate the methods of deep horizontal boring and reaming, and my impression is that I can convey to the minds of the readers no better idea of these operations than by considering the rough and finished boring of the tubes for the modern built-up steel guns.

These tubes, which constitute the central portion of the guns and upon which a series of hoops are shrunk, are composed of a very high quality of special oil-tempered steel. The tubes, according to requirements for the various sizes of guns usually vary in length from 20 to 50 feet with internal diameters from 6 to 30 inches for the large guns, and from 5 to 15 feet in length, with internal diameters from 3 to 6 inches, for the smaller sizes.

Fig. 3. Detail of the Boring Tool.

As it is primarily essential that the bore of these tubes be perfectly straight and the diameter correct and uniform, approaching mathematical accuracy, it might be of interest to point out the simplicity of design and performance of the tools with which this most important operation is performed. The forgings for the tubes as received from the steel works have a surplus amount of metal on the inside and outside, to allow for the boring and turning operations. Owing to

the length being proportionately greater than the diameter they are also, in the majority of cases, more or less warped, due to the processes of oil-tempering and annealing to which they have been subjected. After having ascertained the amount of possible warp and having investigated the concentricity of the inner and outer circumferences, the tube is centered and spotted in a special lathe designated for the purpose, preparatory to the first rough boring. The tool used in rough boring, commonly known as the hog-nosed tool and represented in Fig. 1, consists of a semi-circular cast-iron body provided with a shank on one end secured to the front end of the boring bar (which has a taper and flat keyhole to receive it, Fig. 2), and a cutter clamped on the forward end, the material of which is high-grade tool steel, very carefully tempered. The cutter is made with the edge cutting square on the forward end, and with the lip turned slightly upward, in order to roll the chips backward to free it, as indicated in Fig. 3.

Provision is made to throw a jet of a lubricating mixture in front of the tools during the operations of boring, reaming and finishing, the lubricant serving to diminish the friction on the tools as well as to preserve their temper. This is accomplished by a rotary oil pump which conveys a continuous stream of oil by means of two wrought-iron pipes connected with an intermediate flexible metallic hose which travels with the boring bar and is attached to a fixed pipe which passes through the interior of the boring bar, terminating at the end of the cutting tools. The pump is provided with different changes of speed.

Although this tool, because of its design, is capable of removing a considerable quantity of metal, it has proven most practical not to allow it (though this is seldom required) to remove more than from 0.2 to 0.5 inch of metal on the side, leaving approximately 0.1 inch to be removed by the reaming and finishing tool in the succeeding operations.

The rough boring being completed, the hog-nosed tool is removed and the tool shown in Fig. 4, for finishing and reaming, is inserted in its place. This is made of a cast-iron body about four diameters in length, to which are bolted two semi-circular blocks of carefully-selected and well-seasoned oak or maple that have been previously submerged for a long period in a bath of lard oil and that serve as guides for the double-ended cutter bolted in the front end of the head, as shown in detail in Fig. 4.

These blocks while in position are turned off to a diameter about .005 of an inch larger than the desired bore, the idea being to force them in and thus give them a smooth and uniform bearing surface.

The cutters used are made from a very high-grade steel, ground to exact size and oilstoned to conform to the required diameters.

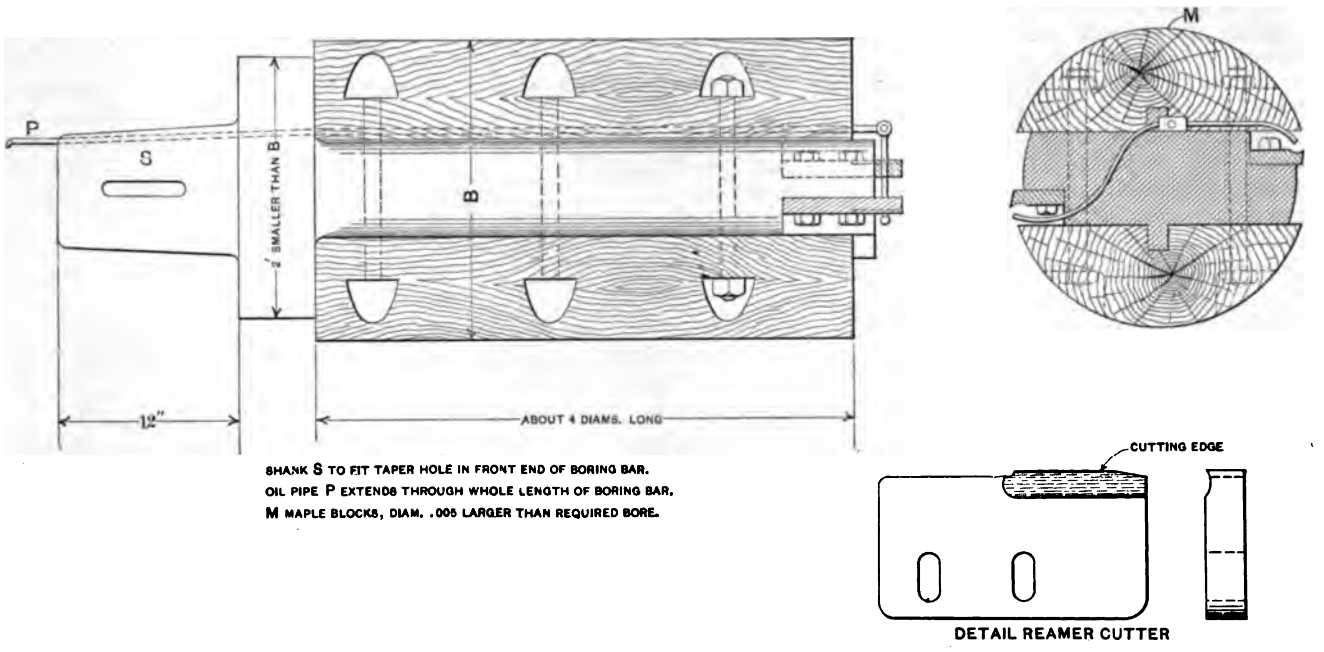
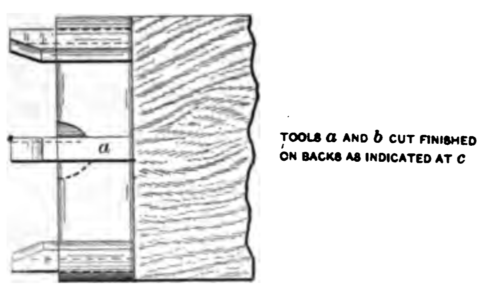


Fig. 4. Tool for Finishing and Reaming the Hole.

To insure a perfect alignment for the tool before commencing the actual reaming, it is good practice to counterbore the tubes from 3 to 6 inches. The method of supplying oil while reaming is the same as employed in the operation of rough boring. It may be of interest to note that, with the same cutting speed, the feed may be from four to five times that of the hog-nosed feed by giving the cutter a taper in front of about 1 to 10, with a straight cutting edge 1 inch long on the side. Such construction also serves to maintain the size in case the forward part of the cutter becomes slightly worn.



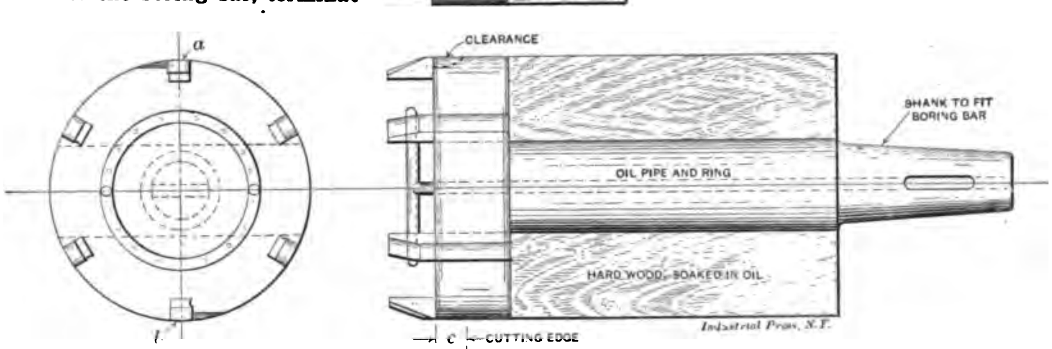


Fig. 5. Boring Tool for Holes from three to six inches in diameter.

Multiple cutter wood reamers, shown in Figs. 5 and 6, have been successfully used for bores of from 3 to 6 inches calibers, for lengths varying from 5 to 15 feet. Greater feed can be obtained from tools thus constructed, and consequently con-

siderable time is saved by this device. It must be borne in mind, however, that in tubes of great length, in which there is an unequal distribution of stock on the interior, this tool has a tendency to run out of its true axis, thus leaving an unsymmetrical bore. This difficulty is obviated and a perfect and uniform bore obtained by the use of the previously described hog-nosed tool and wood-lined reamer, although some time is sacrificed owing to the reduced feeds at which they have to be run compared with the feeds obtainable with a multiple cutter wood reamer.

In boring guns lathes are employed which are specially designed for the purpose. Nevertheless, if such a machine is not available, for short lengths and small bores, it is advisable to use the old and well-known method of attaching to the cross-slide of a common lathe of suitable length of bed a fixed support or bracket having a bore to receive a number of bushes, the bores of which correspond with the varying diameters of boring bars. The hub of this support or bracket has one side split to enable it to be tightened by a bolt, in order to retain and grip the bushing which is likewise split for the purpose of gripping the boring bar. The boring and reaming tools, Figs. 5 and 6, previously described, are particularly applicable in this case.

After having determined the required feed and set the lathe in motion, the carriage will serve to translate the bar in the usual manner. The other functions are performed in the ordinary way and are too obvious for further explanation.

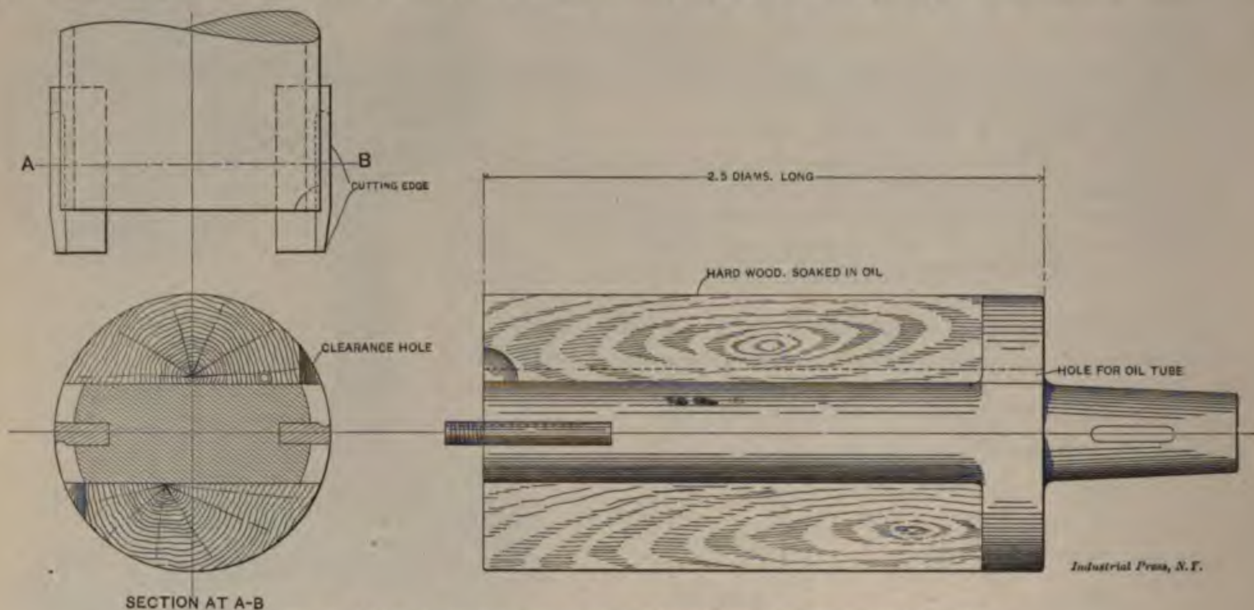


Fig. 6. Another Tool for Boring Holes of from three to six inches in diameter.

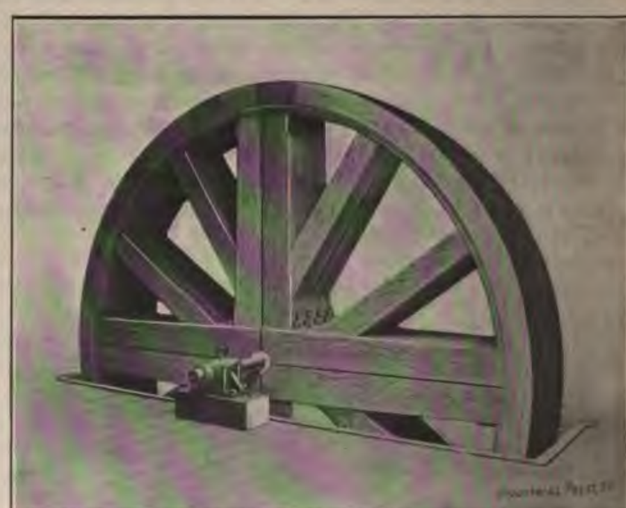
* * *

EMERY COATED TOOLS.

The use of emery tools has been limited because the material does not lend itself readily to shaping, being practically confined to grinding surfaces of simple forms. The galvanic process invented by Joseph Rieder, of Leipzig, however, allows us to make use of any kind of emery powder, and to arrange it in various shapes, so that we are presented with a new style of emery tool. Rieder is known as the inventor of the electro-engraving process, whose characteristic feature is a machine which returns the plaster negative to its position with mathematical accuracy, so that the galvanic etching, which has to be interrupted several times a minute to secure uniform electrolytic action, practically remains continuous. In order to fix the emery sand on the tools referred to above, he first coats the emery with a varnish obtained by dissolving wax or paraffin in benzine. Graphite will adhere to the grains when they have been treated thus, and in this way the emery surface is made electrically conductive. The tool, which is a disk, is placed in the sulphate of copper bath, and the prepared sand dropped on it. Each grain will become imbedded in a coating of copper, and the grains will thus be fixed just as gems have been mounted for some time by means of a galvanoplastic process. The sand can also be treated with a glycerine paste, which is then applied to the surface to be covered with emery. As soon as a thin film of copper has settled on the steel, the glycerine is washed off with hot water, and the copper film is afterward thickened in the bath. In this way emery tools are obtained, which are said to wear very well. Their disadvantage is that they do not cut deeply, because the interstices are filled up. But such disks can be revolved at a much higher rate than we could venture to adopt in the case of an ordinary emery wheel of the same dimensions. Another advantage is that tools of this kind may be constructed in almost any shape.—Engineering.

LARGE WOOD PULLEY.

The pulley illustrated herewith is one of the largest all-wood belt-transmission wheels now running in the United States. It is 16 feet in diameter, the face 31 inches wide, the bore of the hub 8¼ inches and the exact weight of the pulley 13,440 pounds. The material throughout is Southern Indiana oak and the pulley is built in quarters. The arrangement of the arms is interesting, making a neat as well as a very rigid construction. There are four main arms, and from near the base of each smaller arms, in the form of braces, extend on each side to the rim. The photograph is inaccurate in that it does not show the full number of compression bolts at the hub. The small object barely visible on top of the bearing is a four-inch model pulley of the same design as the large one. The pulley was built for the Peters Lumber and Shingle Co., Benton Harbor, Mich., by the Reeves Pulley Co., Columbus, Ind., and was shipped in six weeks from the time the order was placed.



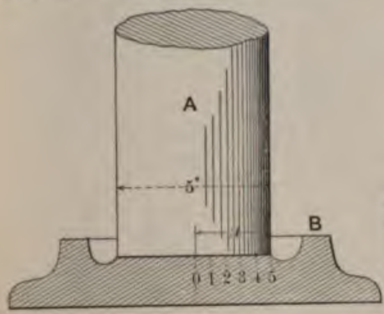
Sixteen-foot Wooden Transmission Pulley.

RADIAL MACHINE BEARINGS.

THE INFLUENCE OF DESIGN UPON THEIR WEARING QUALITIES.

J. Richards.

The term "radial bearing" is in the present case employed to denote machine bearings in which the surfaces are transverse or radial to the axis of rotation, such as collars and flat step bearings. That such a simple matter presents material for discussion may be questioned; but in practice there is abundant room for comment and criticism—perhaps for some useful hints to those whose attention has not been called to the subject. It is purely a feature of construction and one that with a few exceptions seems to have escaped the exhaustive treatment bestowed at this day on everything that permits dissertation.



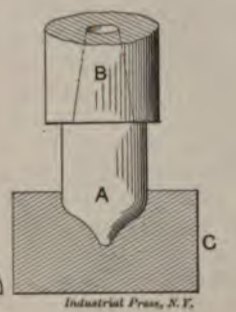
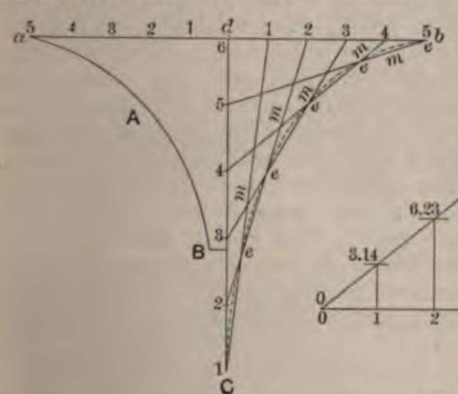


Fig. 1. Fig. 2.

In all kinds of machinery, or, as we may say, in the case of all shafts and spindles, there are two kinds of bearings—one kind parallel to the axis of rotation to resist lateral strain and the other normal to the axis to resist longitudinal strain. The forces to be resisted vary greatly, but sometimes, as in the case of screw propeller shafts, they are equal, the transverse strain being translated into longitudinal thrust. In many cases, drilling machine spindles, for one example, the longitudinal thrust is the principal strain; and vertical shafts frequently bear heavy loads, resting on step bearings, which have long presented a problem to designers of machinery—furnishing one of a few cases where the operative conditions fail to harmonize.

Considering the wear and heating of step bearings to be functions of speed and pressure on their surfaces, these are opposing factors, so to speak, which in the case of step bearings traverse each other. It is well known that in the case



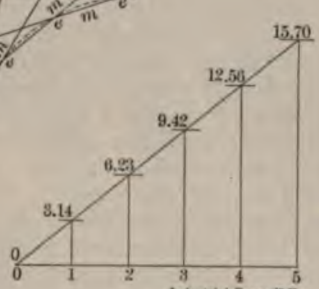


Fig. 6. Fig. 7.

of all bearings, flat or cylindrical, when the surfaces move at uniform velocity there is no difficulty to maintain them within reasonable velocities so long as the common rules of good construction are adhered to. Even the want of uniform pressure in cylindrical bearings is not an impediment to their maintenance; but as soon as the bearing surfaces become radial, or oblique to the axis of rotation, and the pressure is considerable, heat and wear begin.

Down to recent times, and where speed and pressure were much less a feature of machine operation, end thrust or step bearings were successfully made of very hard material and flooded with oil. This answered very well up to a limit where abrasive wear set in. Then such bearings failed and frequently "froze," as it was called, one face being welded to the other, supposedly the result of the lubricant being expelled and a high degree of heat instantly generated. The maintenance of such bearings depended upon a complete absence of wear which occuring, would eliminate uniform contact.

To illustrate the difficulty respecting velocity, suppose that the shaft *A* in Fig. 1, 5 inches in diameter, rests on a flat step *B* and that the radius *a* is divided into five equal parts, as indicated by numerals below, the velocities at these points will, as in Fig. 6, increase from 0 to 15.70 in a radius of 2½ inches or from 0 to 3.14 in a shaft 1 inch in diameter. Considering velocity as one and perhaps the principal cause of wear, it is easy to perceive what a contradictory set of conditions is here set up and how impossible it is to compensate wear of the surfaces. If pressure, the other factor of wear, be added, it is plain that quick destruction must follow if abrasion or even the slightest reduction of the surfaces takes place. Reverting again to Fig. 1 and supposing the material to be inelastic, the slightest wear, even the thousandth of an inch, in the outer zone, would shift the whole pressure to the remaining four and so on to the center, where the intensity of pressure would cause more rapid wear, producing curved surfaces. This is what takes place. The writer when a young man enjoyed the distinction of being a shop foreman in an establishment where a portion of the equipment consisted of ten or more small lathes for turning tool handles, that ran at speeds from 1,500 to 2,500 revolutions per minute.

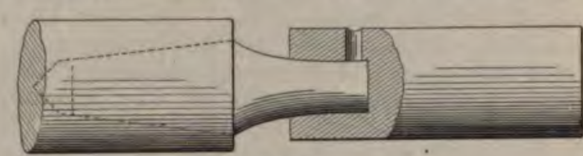


Fig.3

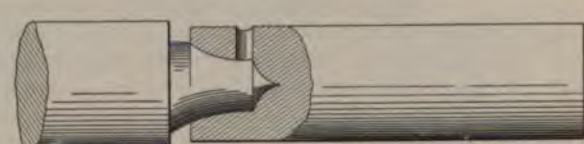


Fig.4

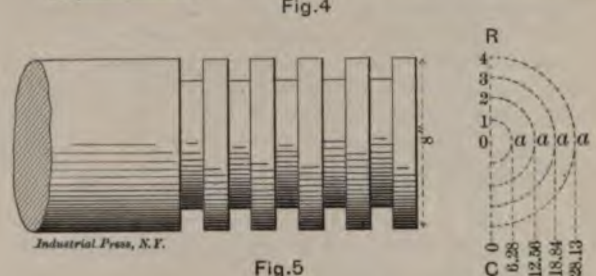


Fig.5

The hardwood blanks were put in the lathes while in motion and were screwed up with about all the force that could be applied on hand wheels from eight to twelve inches in diameter, to drive the claw centers into the work. The pressure required was from 500 to 1,000 pounds. The wear of the spindle thrust bearings was rapid and they required continual attention, with new points once a month at least. These thrust bearings, which were also the rear supports for the spindles, were made at first as in Fig. 3, of the finest tool steel and "salt hardened." Spare centers were kept on hand, made to uniform size and, as remarked, it required but a short time to wear them into a form like that in Fig. 4, which is sketched from memory. We were repeating Mr. Schiele's experiment, which was to fasten a blunt cylindrical bar of chalk *A* into a drilling spindle *B* and bore this down into a solid block of chalk *C*, as in Fig. 2, by abrasive action. The result was always the same, the form being something as shown. From this he developed the assumed theory that compensation for wear in a bearing of any kind should be at all points in proportion to the velocity at which surfaces move at these points. This leads to the parabolic curve illustrated in Fig. 6, generated as follows:

Draw the lines *a b* and *c d*, the first representing the extreme diameter of the shaft or spindle and *c d* its axis. Set off on *a b* a number of spaces, 1, 2, 3, 4, 5, and on *c d* other equal spaces numbered to correspond and to suit the desired length

of the bearing. Then join these spaces by the lines *m* and the intersections *e* will be in the path of the curve *A*, as shown on the left.

The wear of radial bearings into a curved form is a convincing clue to their true form, or rather to their best form, because it is evident that compensation for both pressure and velocity is not possible. They are in opposition, both following the curve in Fig. 6 in the same direction in similar degree, and a compromise would demand some impracticable form difficult to attain in common practice.

When marine screw propellers came into use various means of resisting the end thrust of the shafts were tried. There were hardened steel bearings flooded with oil, various kinds of compositions and alloys, surfaces of large and small area, hydraulic steps and so on; but natural selection in time brought a series of shallow collars that ended the difficulty. Whether this device was blundered upon by experiment or was the result of "natural selection" it is hard to determine now. The expedient was adopted fifty years ago by Mr. Boyden to sustain the large Fourneyron turbine wheels at Lowell, Mass., and it had been employed, no doubt, long before in exceptional cases. It is a simple, and is no doubt the final, means of resisting the thrust of shafts, being in fact a near approach harmonizing velocity and pressure of the bearing surfaces. For example, if in Fig. 5 a shaft 8 inches diameter is provided with five thrust collars 1 inch deep, the sum of the bearing surface will be $21.99 \times 5 = 109.95$ inches, or more than twice the area of the shaft's cross-section, and the variation of speed between the outer and inner diameters of the collars will be within 25 per cent of uniformity and the mean variation half as much, or quite within the conditions of maintenance, with copious lubrication. Such bearings, as everyone knows, have to sustain for weeks or months even, without cessation, a thrust of thousands of horse power, seldom causing any difficulty, and furnish, as before remarked, a practical solution of the problem of radial bearing surfaces.

The unnatural conditions under which radial bearing surfaces have to operate are mainly responsible for what Mr. Thompson, of the Buckeye Engine Co., calls the "rotary engine malady," which has cost millions of capital and much lost effort. I have yet the first case to meet with where an inventor and designer of a rotary engine has set out with a recognition of the want of uniform velocity in the bearing surfaces that have to be kept steam-tight. The evil of radial bearing surfaces crops out in many unsuspected places, many in which it would be avoidable if the action and results were better known. A stipulation in specifications for machinery requiring that the velocity between all bearing surfaces should be within a certain per cent of uniformity, would soon settle this matter. This would be reasonable and practicable; but it requires "starting."

* * *

INDUSTRIAL BETTERMENT.

AN INTERESTING GROUP OF VIEWS FROM A CLEVELAND PLANT.

During the past two years the Cleveland Twist Drill Co., Cleveland, O., have added a new building to their factory, have installed one of the most complete power and electrical transmission plants with which we are acquainted, and have built spacious offices that are models of convenience. While engaged in making these improvements, the company also considered features that would lend to the comfort and convenience of their employees, which have been successfully introduced, and while much pride is taken in the remodeled factory, even more satisfaction is felt by the management in these industrial improvements.

The interesting collection of views on the opposite page shows what some of these improvements are. Perhaps quite as important as anything is that the workmen have a clean and convenient place for keeping the clothes worn when going to and from the factory and for storing any possessions they wish to keep in safety during the working hours. In Fig. 1 is a view of individual metal lockers that have been introduced throughout the factory. They have been found so desirable that individual lockers have also been adopted for the office force, which, however, are of wood instead of metal, to be in keeping with the finish used in the offices. Each workman has a key to his own locker which will not fit any other locker, so that his clothing is safe from molestation; and the fact that the walls of the lockers are made of a heavy open wire mesh insures ample ventilation and a thoroughly wholesome condition. Fig. 2 shows conditions as they were before the introduction of these lockers, and needs no comment.

Figs. 3 to 6 inclusive illustrate the arrangements that have been adopted to provide a comfortable dinner or lunch for any of the employees desiring it during the noon hour. Fig. 3 shows the tables set for dinner. In the foreground at the left is the bill of fare for the day when the photograph was taken, which is typical of the menu provided every day. The "contents" are as follows: Cream of barley soup, two cents; roast veal, five cents; green peas, two cents; mashed potato, one cent; sandwiches two cents; pie, three cents; coffee or tea, one cent; crackers, one cent. For seventeen cents, therefore, a person can be served with each kind of food on the bill of fare. A hearty dinner can easily be obtained for fifteen cents and a good lunch for ten cents, or less. If preferred, an employee can bring a cold lunch with him and simply order what warm food or drink he would like to go with it.

The tables are capable of seating 180 at dinner at one time and it will be noticed in Fig. 3 that there are cards suspended over the tables bearing numbers, that divide the tables into sections. This is for convenience in arranging the service at the tables. A certain number of persons are assigned to each section and of these certain ones are appointed from each section to act as waiters for a length of time decided upon, as one or two weeks. After they have served their time, others are appointed, etc., in rotation. The waiters are excused from their work in the factory fifteen minutes before closing time and they repair to the dining room to set the tables. In Fig. 6 the waiters are shown lined up, with their trays, to receive food from the cook.

By this method the expenses and annoyances incident to the employment of regular waiters are avoided. An expert cook and assistant cook are employed, and the price charged for the food is just enough to cover the cost of the food itself, the other expenses being borne by the management. Fig. 4 is from a photograph taken during the dinner hour, and Fig. 5 shows a model kitchen.

On the same floor with the dining room is a large space fitted up as a reading room. Files of the leading technical and general magazines are supplied and there are also copies of the leading Cleveland daily papers. This room is open during the noon hour and affords a comfortable meeting place. There is also a piano, to help brighten the hour, and music and song are indulged in at pleasure. A view of this room appears in Fig. 7, and in the center of the illustration will be noticed a tall case which is supplied with books by the Public Library of Cleveland. The case is filled with a collection of new books at regular intervals and employees may here draw out books desired by themselves or their families, without the trouble of going to the main library building for them.

In Fig. 8 is an illustration from a photograph of an evening drawing school in the same building. Classes are held two nights a week in English, mathematics, and mechanical drawing. All the expense of the night classes is borne by the company, who employ first-class teachers, and the classes are open to any employee who chooses to attend. There is also a benefit association among the employees which is in the nature of an accident insurance, each employee contributing a certain amount to the association each pay day until the funds reach a certain stated amount, when the dues are omitted until, through an accident or the sickness of some employee, the funds are reduced and the dues are again paid in until the original amount is made good. Among other innovations in connection with this scheme of industrial betterment is a suggestion box, and many valuable suggestions have come by means of the hints given by employees.

Figs. 1 and 2. The New and the Old. Fig. 3. Tables set for Dinner. Fig. 4. At Dinner. Fig. 5. Where the Cook holds forth. Fig. 6. The Waiters are ready. Fig. 7. During the Noon Hour. Fig. 8. Evening Class in Drawing.

VIEWS AT THE WORKS OF THE CLEVELAND TWIST DRILL COMPANY

TOOLS FOR INTERCHANGEABLE MANUFACTURING.—6.

MILLING FIXTURES FOR ACCURATE WORK.

JOSEPH VINCENT WOODWORTH.

We are now about to take up a class of milling fixtures of a different type from those described in the last article, in that they are more intricate and are also capable of producing more accurate results. When designing these tools there are three questions to be considered: First, Are the parts which are to be machined required in large quantities? Second, Must they be finished very accurately, so as to be interchangeable, and lastly, Can the parts be handled and finished to the best advantage on the milling machine?

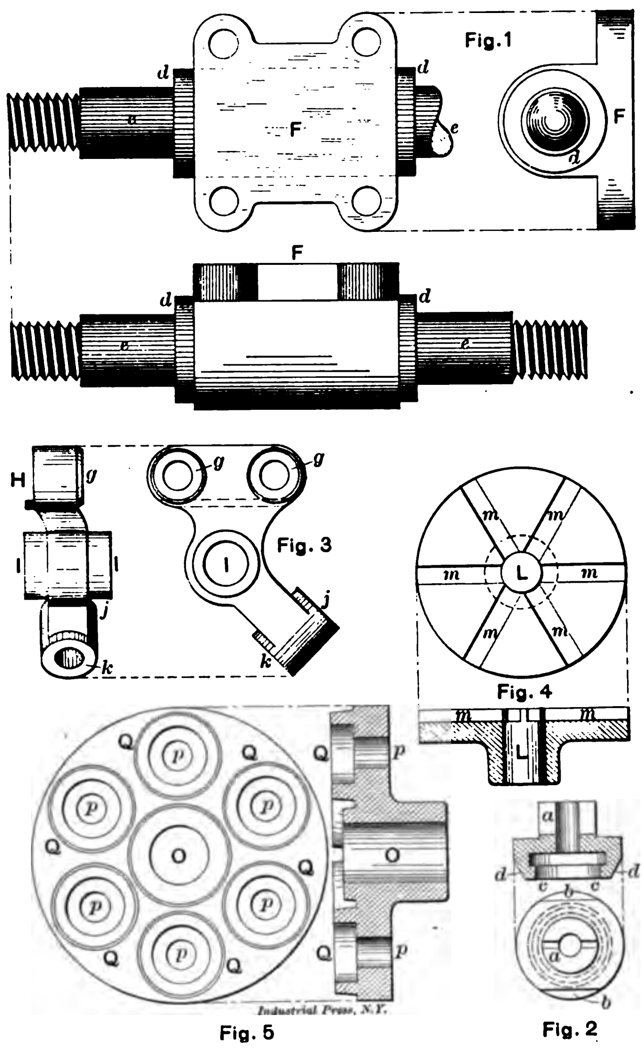


Fig. 5 Fig. 2

Sketches of Pieces for which the Jigs Illustrated in this Article were Designed.

The first two questions can be answered in very short order, but in deciding the answer to the last one, the knowledge and skill of the designer—who is often the constructor as well—is put to the test. If it is decided that the milling machine is most suitable for the work, the following points must then be considered, after the shape and type of the fixture have been determined: The surfaces by which the pieces are to be located; the devices for fastening the work, and the most practical way of presenting the surfaces to be machined to the cutter or cutters, as the case may be.

As types of the most reliable class of milling machine fixtures for duplicating small and medium machine parts there are here shown five examples which are well designed for the particular pieces of work for which they are intended. The devices also are suggested, in that many of their features can be so modified as to be applicable to work of other kinds. Methods for constructing the fixtures will be described, explaining how they can be produced within a reasonable length of time and a moderate expense.

Jig for the First Piece of Work.

The first fixture is the one shown in the three views of Fig. 6, used for facing the flat surface of the work in Fig. 1. The finishing of the ends of the piece is accomplished in the lathe, the parts *e e*, *d d* and the threaded portions being interchangeable. The fixture, Fig. 6, for facing the flat surface *F* true with the turned portions of the work is of few parts, and holds the work rigidly. As the method of construction is not very intricate, and can be understood from the illustrations, a slight description will suffice. The fixture proper consists of the body casting *G*, the standards *H* between which the work is located, the back projection *I*, for the fastening and locating screws *N N* and *O O*, respectively, and the two clamping lids *J J*. The lid clamping screws *L L* are fastened in a slot in the standards, as shown in the face view, by means of a Stubs steel pin, so they may be fastened and released as rapidly as possible. The lids *J J* are hinged as shown at *K*. The locating screws *O O* are of tool steel and are reduced at the ends as shown at *P*, in the end view, and hardened and equipped with jam nuts. The tongue *T* is let into a slot in the bottom of body casting *G* so as to be perfectly in line with the turned portion of the work when within the fixture.

The boring of the standards and lids to size, and the facing of the surfaces *M M* so that the work will fit between them snugly, is accomplished in the following manner: The base is first planed, and the body casting strapped to an angle plate on the drill-press table. A boring bar is then used, with the end running in a bushing in the table, and the holes are bored and the shoulders faced. The two screws *N N* for forcing the work against the two locating screws *O O* have knurled heads with a spanner hole as shown, are threaded to screw freely in the tapped holes and are also equipped with jam nuts.

When using this fixture it is clamped on the miller table with the tongue *T* in the slot nearest the spindle. The two lids *J J* are then thrown back, and the work located as shown, first tightening the lids, and then forcing the work against the two locating screws *O O* by means of the knurled head screws *N N* and fastening the nuts to keep them tightly against the work. The cross feed of the miller table is then clamped so that the cutter will remove the amount of stock required, and the face is milled, using a large face cutter and running it so that the cut will be downward, thereby taking the strain off the fastening screws *N N*, and keeping the work against the ends of the locating screws *O O*. The facing of work of this class by fixtures of the type shown can be accomplished to a greater degree of interchangeability and in less time than by any means known to the writer.

Jig for Use in Milling the Second Piece.

In Fig. 7 we have a milling fixture of a more intricate type, and one which for rapid locating, fastening, and releasing of the work when finished, would be hard to beat, as one turn of a screw fastens or releases, as required. This fixture is constructed for the accommodation of two pieces at a time, and could, if required, be constructed for twelve on the same principle. The fixture was designed for milling work of the shape shown in Fig. 2. The piece was of machine steel and was finished all but the milling in the turret lathe, and was used as a part of an electric cloth-cutting machine which was being manufactured in large numbers. The milling consisted of a slot through the stem at *a*, and a flat at either side of the largest circular portion, as shown at *b b*.

The fixture consists of two castings *P* and *E*, and spring chuck devices, in which *I I* are tool steel pieces screwing into the casting *E* and carrying the spring jaws *K*. These jaws are forced out against the work by the expanders *L L*, which screw in threaded holes in *I I*. The one point in the construction of this fixture most worthy of a detailed description is the manner of finishing the locating depressions *F F* in the part *E*. This part is of cast iron with a projecting lug at *M*, which is used when finished as a gage for setting the three cutters which mill the work. This cast-iron block is first planed on all sides, and one side *N* finished dovetail to fit tightly into the dovetailed channel milled in the body casting *P*. This channel, by the way, was milled and the front of the casting faced after the base had been finished and the groove for the tongue was milled, on the machine on which the fixture was to be used, to guard against inaccuracy.

The block *E* was driven into this channel and fastened by two screws, shown at *R*. The position of the centers for the

locating depressions *F F*, *F F*, were then located so as to be dead in line with each other by the button method described in a previous article. The depressions were finished and the holes bored and threaded at the back by strapping the block *E* on the lathe faceplate, truing the buttons, boring the holes, finishing the formed depression to exactly the shape and depth by means of a forming tool, and then reversing the work and enlarging and finishing the holes at the back, as shown. two pieces of work at once, and can be constructed for the accommodation of a dozen, if desired. One casting *A* is all that is required for this fixture, and is in the shape of an angle plate with projecting bosses at the front and back at *B B*, as surfacing points for the work, and four projecting lugs on the face, of which *E E* are for the locating points and *D D* for the fastening screws. For clamping the work in position a device is used which allows the work to be fastened

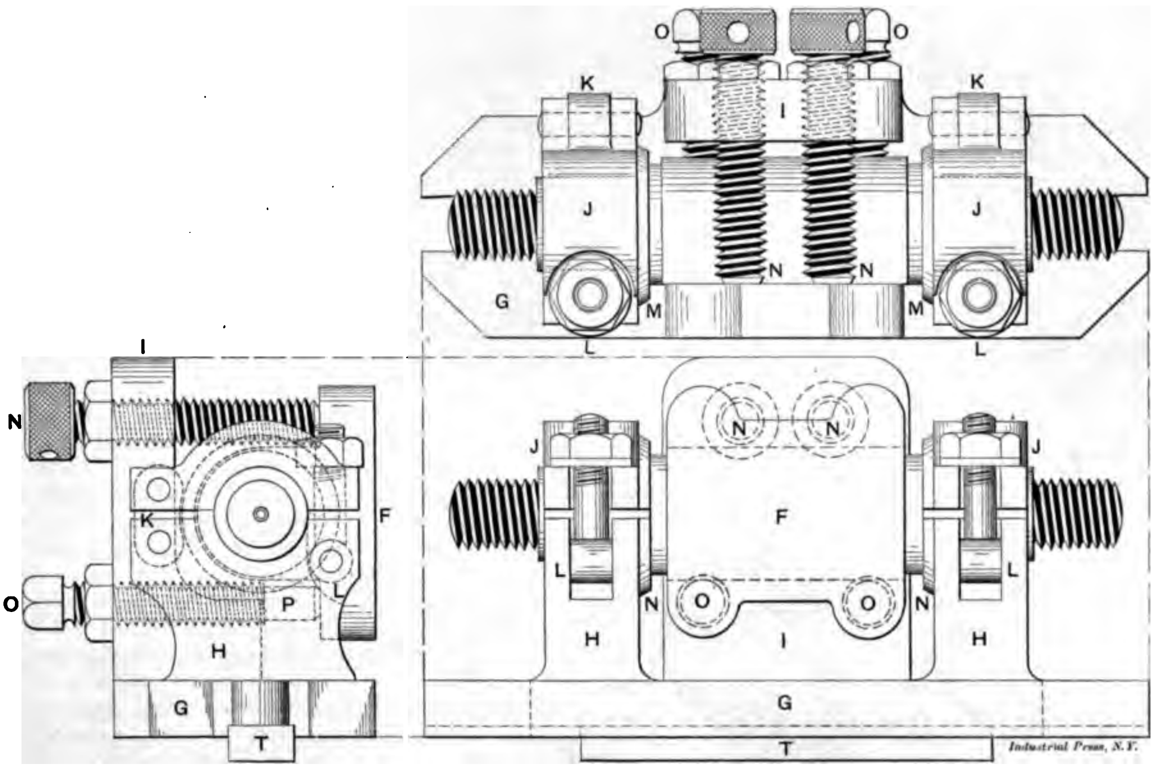


Fig. 6. Fixture for Face Milling the Flat Surface of the Work shown in Fig. 1.

When the fixture is in use, the work is held down on the locating face *F F* by hand and the expander given a turn by the handle *J*. This causes the spring chuck *K* to grip the work and draw it down on the locating face. The cutters are then set by the gage *M*, and the work milled.

Description of Fixture for the Third Piece.

In Fig. 3 are two views of a piece which is an ideal job for the milling machine. It is a cast-iron spindle bracket, and the or removed with the greatest rapidity. It is shown clearly in the sectional view of the fixture, and consists of a stud *M* of tool steel, which is turned to fit nicely the hole *I* in the work and *L* in the fixture. It is of the same diameter its entire length and is threaded at the end *P* for the nut *S*, and reduced as shown in *N* to admit the clamping washer *Q*. This washer is of tool steel and is knurled on the outside so it can be easily removed, and has a section cut out as shown for slipping it

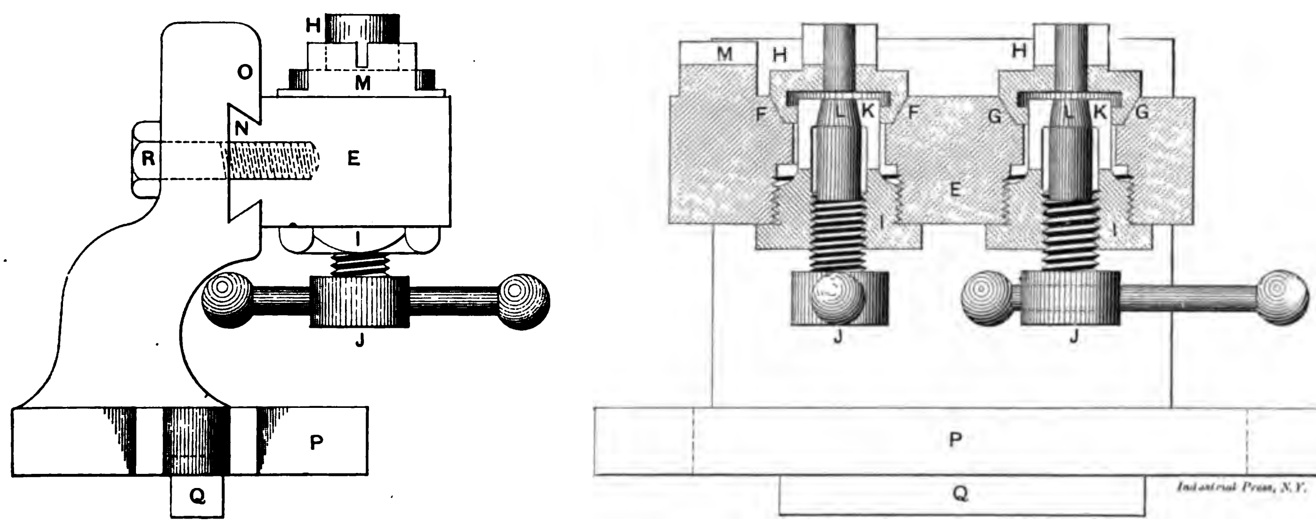


Fig. 7. Fixture with Spring Clamp for Holding the Work shown in Fig. 2.

milling operation consists of facing the fronts and backs of the two bosses and finishing the projecting rib *H* at a certain distance from center of hole *I* and at a right angle with the hole *k*. Before milling the hole *I* is bored and one side of the hub faced in the turret lathe. The opposite side is then faced and the two holes drilled through *g g* and one through *k*. The side *j* is faced in a special jig and all points machined are interchangeable.

The milling fixture is shown in Fig. 8. It is designed to hold into the reduced channel *N* of the stud *M*. The locating faces of the lugs *E E* are faced at right angles with the stud *M*, so that when the faced portion *J* of the work is forced against the locating face it will rest perfectly flat and bear all over. The fastening screws *U U* are reduced at the ends *W W*, ending in a square shoulder for the washers *V V*. The head of the clamping stud *M* is milled with a flat on two sides for a wrench.

When in use the fixture is clamped to the miller table with

the tongue C in the central slot. The nuts P of the clamping studs are then loosened, the work slipped on as shown, the clamping washers $Q\ Q$ located and the nuts P tightened by using wrenches on them and on the end $O\ O$ of the studs. The

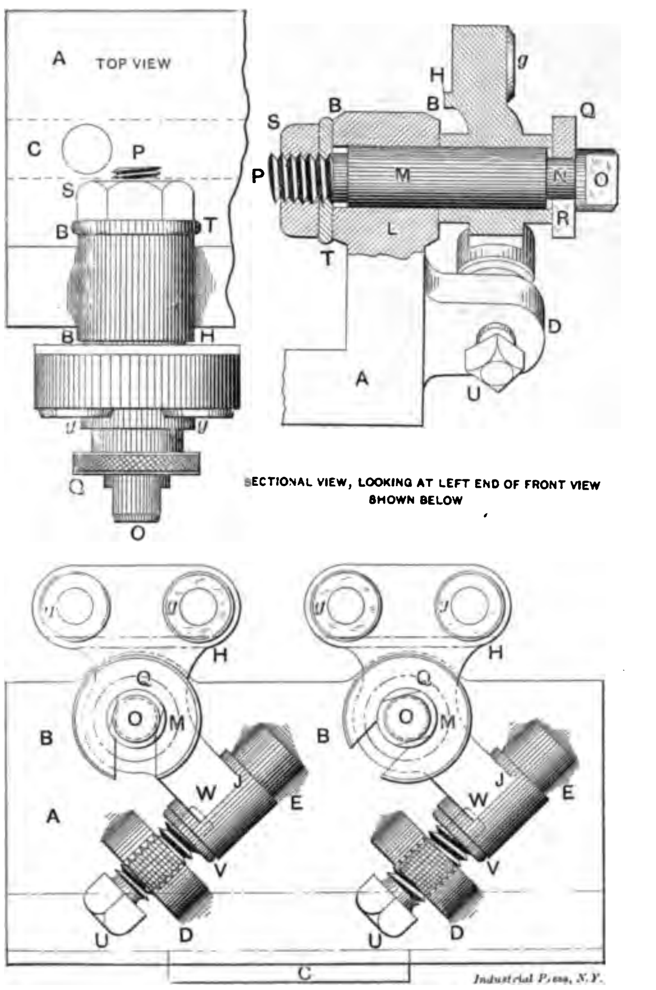


Fig. 8. Fixture Used for Face Milling both Sides of the Irregular Shaped Casting shown in Fig. 3.

work is then forced against the locating lugs $E\ E$ by the setscrews $U\ U$, and milled as shown by setting a pair of straddle mills for the proper depth of cut and clamping the cross feed of the miller table. To remove the work all that is required is to loosen the setscrews $U\ U$ and the nuts P, slip off the washers $Q\ Q$, and remove the work. The rapidity with which this fixture can be operated and the perfect interchangeability of the work produced is surprising. The device shown for clamping the work is far superior to the usual methods adopted.

Indexing Milling Fixtures for Pieces Figs. 4 and 5.

As there is a large variety of circular-shaped machine parts to be milled at different points regularly spaced, we show in the last two illustrations two types of indexing milling fixtures in which simple means are used for the attainment of the results indicated in the sketches of pieces shown in Figs. 4 and 5. The first of the two fixtures, the one shown in two views in Fig. 9, is used for milling the six equally-spaced channels M in the disk, Fig. 4. The castings for these parts are finished all over in the turret lathe to the shape shown, and are then milled two at a time on the fixture, Fig. 9. The illustrations show a plan and cross-section view respectively, and as the design and method of construction can be understood from them, very little description is necessary. A is the fixture proper, the work being located centrally on the studs $E\ E$, which are let into the base and located for height on the faced surfaces $C\ C$, as shown in the cross section. The holes in which the studs $E\ E$ are located are bored sufficiently large to give clearance for the hubs of the work, as shown at D. The high projecting lugs $B\ B$, $B\ B$ are surfaced so as to allow the clamps $N\ N\ N\ N$, two to each part, to clamp the work securely. The indexing device is shown in the plan view and is self-explanatory. The projecting lug at the right end of the work has a slot milled through it in a central line with the central locating studs $E\ E$, and to the depth required, thus serving as a gage for the depth of cut.

When in use the work is located and fastened as shown, only that the indexing pins are out. A cut is then taken down through both parts, as shown by the arrows, to $X\ X$. The table is then run back, the clamps slacked and the work moved until the index pins $H\ H$ enter the channels just milled. Tightening the screw J of each to hold it securely, the cutter is run through again, and the operation repeated. The work is then removed by loosening the clamp bolts O and sliding the clamps back, provision being made for this by slotting the bolt holes in the clamps, as shown at $Q\ Q$ in the cross section. By changing the location of the indexing device work may be milled with any number of slots or grooves, in fact there is an inexhaustible variety of work for which fixtures of this design can be adapted with the best results.

Fix. 10 shows two views of a fixture, the use of which demonstrates how work which is very often produced on jigs on the drill press may be machined in a better manner by the use of simple fixtures on the milling machine. The fixture is used for counterboring and facing the six bosses of the spindle disk casting, shown in two views in Fig. 5. The points previously machined are the hole O, the six holes marked p, and the two hubs, all being finished to interchange. The fixture consists of the angle plate A, which has a projecting hub on

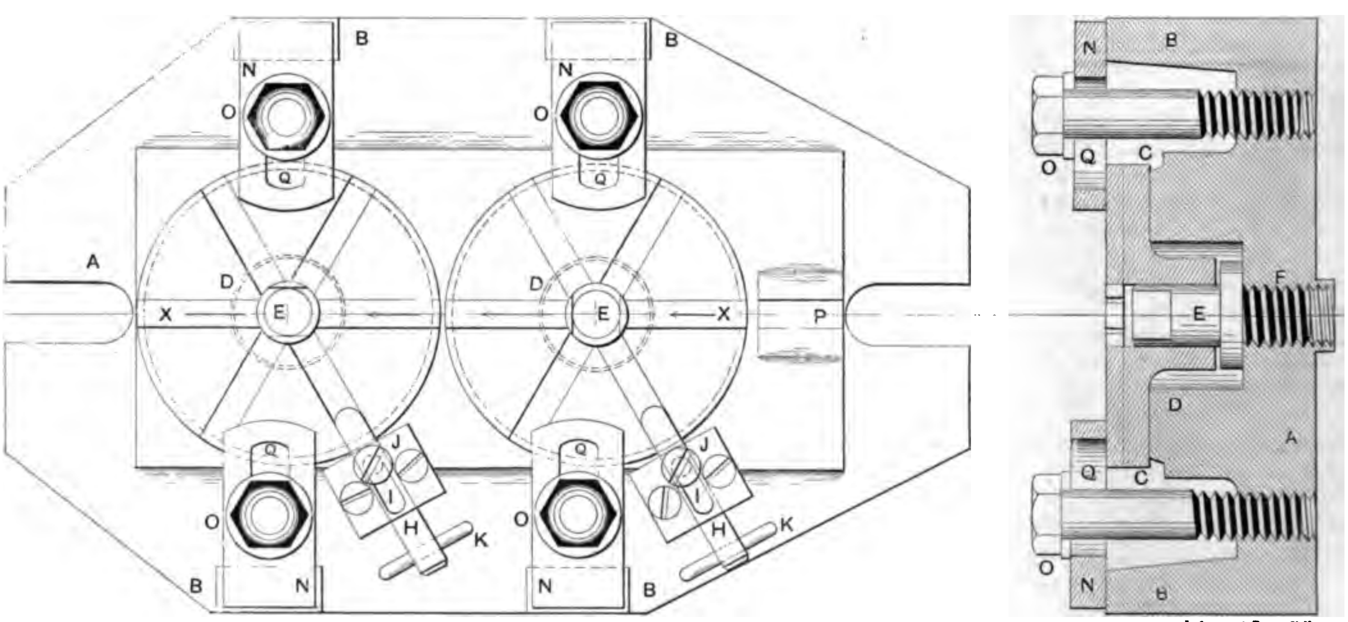


Fig. 9 Milling Fixture for Indexing and Milling the Six Channels in the Work, Fig. 4.

either side at *D* and *B*, the central locating stud and the indexing pin *O*. After the angle plate is planed on the bottom it is fastened on a shop angle plate on the lathe faceplate, and the hub *D* faced. A hole is then bored straight through the center of the hubs and reamed to size and counterbored to the diameter and depth shown in the sectional view, for clearance for the hub *F* of the work. It is then transferred to the planer where the hub *B* is faced and the channel let in for the tongue. The central locating stud is then finished so as to shoulder at *H*, and reduced and threaded at the back end for the washer *K* and the jam nuts *L L*, so as to revolve freely and without play within the fixture. The fixture is now drilled for two hardened steel bushings, one at *R* for the index pin *O* and one diametrically opposite at *S*. To properly locate these bushings the work is fastened on the central stud *I* and the hole for the index pin bushing *R* is finished first by drilling through one of the holes *P* in the work, which is then removed and the hole counterbored to admit the bushing *R*, as shown by the dotted lines. The hole in this bushing is lapped to exactly the same diameter as the six reamed holes *P* in the work. The index pin *O* is then made of tool steel, the head being knurled as shown, and is then hardened and ground to fit snugly within the reamed holes *P* in the work, and the bushing *R* in the fixture. The work is then refastened on the fixture, being located by entering index pin *O* through one of the holes *P*, and into the bushing *R*; and the hole for bushing *S* finished and the bushing entered in the same manner as the other.

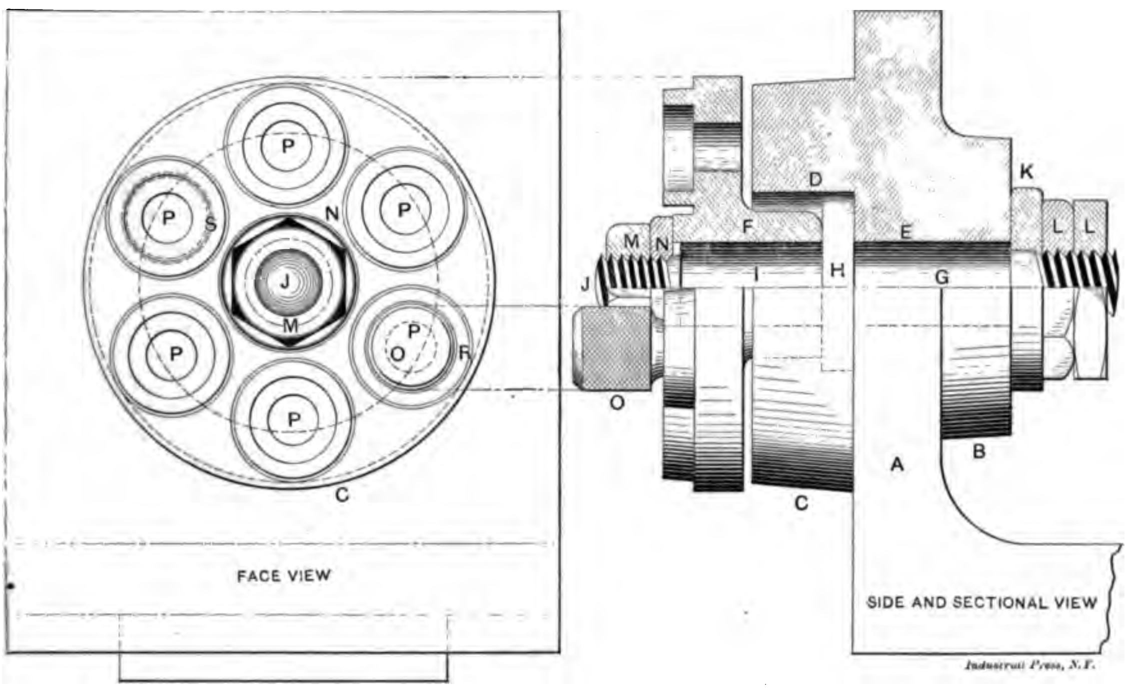


Fig. 10. Fixture for Milling and Counterboring the Bosses in the Piece shown in Fig. 5.

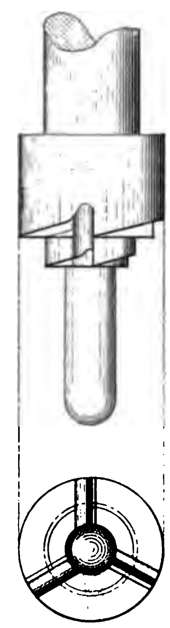


Fig. 11. Combination Counterboring and Facing Tool used with the Fixture in Fig. 10.

To operate, the work is fastened on the fixture as shown, and the counterbore fastened in a taper sleeve in the miller spindle. The longitudinal and cross feed of the table are then manipulated until the lead or supporting stud of the counterbore is in line with, and can be entered into, the bushing *S*. The work is then fed against the cutter until the required amount of stock has been removed and the graduated dial on the cross feed screw set at *O*. The table is then moved back, index pin *O* removed, and the wórk revolved until the next hole *P* is in line with the bushing *R*. The index pin is then re-entered and the operation of counterboring and facing repeated, and so on until all six of the bosses have been machined.

* * *

The engines for the New York Rapid Transit subway power house are to be made by the Allis-Chalmers Co., and are to be of the combined horizontal and vertical type, like those for the Manhattan power house. They will be rated at 7,500 horse power each at the most economical point of cut-off, and will be capable of operating continuously under a load of 11,000 horse power each.

LYCOPODIUM POWDER IN THE FOUNDRY.

Lycopodium is a vegetable powder used by pyrotechnists and theatrical mechanics to produce a lightning-like flash effect sometimes needed in their business, and by druggists to sprinkle on pills, not otherwise coated, to prevent same from adhering to one another, and the purpose of this article is to advise founders to use it for the same reason that the druggist does, only in a slightly different manner and on very dissimilar material.

I refer to its use by a few founders here in the East to prevent the sand from clinging to patterns, both wood and metal, especially on molding machine work, and were it not that the founders referred to regard their knowledge of it as a dark secret to be jealously guarded from competitors, and are not broad enough in their views to exchange ideas with their fellow foundrymen, this article had better remain unwritten.

By the use of lycopodium, patterns that are considered nasty to draw are rendered, by a very light sprinkling from the dust bag containing this chemical, as easy to mold as the proverbial sashweight. It will be found invaluable as a means for drawing in loose pieces on big work, as practically no rapping is necessary, the piece fairly jumping out as a result of the least jar. For getting the best finish on names and numbers that are made of the usual lead pattern letters and figures and fastened on so that they only touch the pattern in spots, leaving open joints underneath for the sand to stick in and thus mar what would otherwise be a fine job, lycopodium is as the Balm of Gilead to the heartsick founder who is tired of having castings sent back because an A was made to look more like a Z by these very conditions.

On large work it is sometimes used when there is a deep draw with little if any draft, and to make it stick on the vertical sides or faces some founders spray gasoline or naphtha on the pattern. Before evaporation on the one hand and capillary attraction on the other claim the oil as their own, "lyco" is sprinkled on so that it "cakes," and by this method you can riddle or shovel sand into the mold without fear of displacing the dust that has a specific gravity of only .5.

Send the "cub" to the nearest drug store for a nickel's worth and put it in a bag made of goods not too loosely woven and give it a "try," at least, on your molding machine patterns, and I think you'll like it; and you needn't be afraid of an explosion or rumpus of any kind, when the hot metal strikes it, due to its pill-separating and lightning-producing qualities, even in conjunction with gasoline or naphtha, as there is absolutely no danger.—*Patternmaker* in the Foundry.

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MACHINERY

A Practical Journal for the Machine Shop.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

DECEMBER, 1901.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

1901.		1901.		1901.		1901.	
Jan.....	27,500	April....	26,000	July.....	28,964	Oct......	28,345
Feb.....	26,500	May....	26,500	Aug....	29,492	Nov.....	31,748
Mar....	30,000	June....	28,000	Sept....	28,165	Dec.....	29,287

No other paper in this field prints its circulation figures.

It is a matter of common knowledge among machinists that a large surface plate is likely to become inaccurate after much use, more because of the pening action of the work applied to the surface than by the wear. This is especially true of surface plates used in blacksmith shops for straightening bars. Such plates will soon become high in the center because the upper surfaces have been pened by the repeated blows into a state of compression which warps the sides of the plate downward. The same condition is sometimes met on planer platens. That planing off a platen pened out of truth by any cause will again put it in good condition depends somewhat on the amount it is out. If it is found "humped up" ⅜ inch in the center and is planed off without an attempt being made to modify the "hump," as in one case known, the result in all probability would not be a very satisfactory one. The best practice in such cases, as in most others, is prevention. By deeply scoring the surface of platens with lines two inches apart, both laterally and longitudinally, cut by a sharp narrow tool which will sink in quite deeply without cutting a wide track, the trouble will be overcome, without in any way harming them. Then the occasional planing off of the surface will merely remove the local inaccuracies and nothing more than a "skin" cut will be necessary.

* * *

A PIECEWORK-PREMIUM SYSTEM.

In starting a piecework system it is generally determined from the cost cards how much a man has been producing when working at a day's pay and when he is placed under the new system he is told that thereafter he will be paid so much per piece and will be paid by the piece only. The price is set at a figure that compels the man to work faster to earn even as much as he did before, and he well knows that if he works very much harder and increases his wages very largely the price will again be cut; and so for his own protection and the protection of those who may follow him on the same work he is careful to keep his wages within the "safe" limit. Under these conditions the man feels that there is no certainty for the future and becomes suspicious of those above him.

In isolated cases we hear of the premium plan of payment being used in lieu of the piecework system, and it is generally considered to be more fair and liberal toward the employee and by some more profitable for the employer. It is substantially a direct proposition made by the employer to his employed and the latter are in a measure free to accept it or not; although one who habitually refuses may find himself in disfavor and perhaps out of employment. In applying the premium plan a foreman approaches his men and in effect says: "Our time record shows that it takes you an hour, on an average, to complete one of the pieces you are to work upon. If you will work harder or devise some improvement to enable you to make more pieces per day, we will pay you half your hourly rate for every hour you save over the present time of sixty minutes for each piece. If instead of completing a piece in sixty minutes you succeed in finishing one every forty-five minutes you will receive, in addition to your day's pay, half rate for the two and one-half hours that you will save in a ten-hour day, making about thirty cents added to your previous wages of $2.50. You will, in any case, continue your regular pay of $2.50 per day whether you take advantage of our offer or not, as long as you stay in our employ, and no matter how much you may succeed in earning, your wages and rate of increase agreed to under this proposition will not be reduced."

It does not appear to us, however, that the difference between the piecework system and the premium plan lies so much in the system itself as in the disposition or the intention that is behind it. There is really no fundamental difference in principle between paying a man so much per piece for every piece of work that he finishes and paying him so much for every hour saved. In either case it is expected that the rate will be so fixed that the manufacturer will increase his profits through the introduction of the system.

The great evil of the piecework system is the disposition on the part of the manufacturer to cut the rate occasionally. Where the disposition to do this exists, however, it is just as easy to arrange it so that a workman cannot earn more than a stipulated amount under the premium plan as under the piecework system. It is simply necessary to devise new jigs or methods for doing the work and then to adopt new rates of payment, with the new methods as an excuse. This, in fact, is sometimes done when the manager thinks a workman is accumulating more wealth than is good for him.

When the premium plan is adopted it is with an evident disposition toward fairness, and this counts more than any mere details of system. The fact is recognized that it is better to guarantee a man his day rate, regardless of his production—discharging him if he does not do his duty—than to require him to receive a smaller amount when his production falls off. It is admitted that it is better to fix a rate equitable to both sides and to agree to adhere to it rather than to place the man in fear of a reduction in the rate and so cause him to curtail the production to ward off the threatened cut in rates. These are the features of the premium plan that distinguish it among other systems.

But are these features such that they could not be applied equally well to the piecework system? It is probable that no concern would be willing to pay wages under any system that were considered exorbitant for the services rendered and no reasonable workman would expect to receive exorbitant compensation. Suppose it was recognized at the outset that such was the case, and that with this understanding specific agreements were made with the employees to pay them certain piecework rates which were to hold for certain lengths of time, as a year, with the understanding that at the end of that time there should be a new agreement. The period should be long enough so that if the workman was able to introduce any new device to cheapen the cost of production, he could derive ample compensation for his invention in the way of increased wages before his agreement ran out.

Suppose it were also agreed that a man should receive his day rate regardless of the amount of production, as in the premium plan, making his acceptance of the terms to a certain extent optional.

Under such conditions as these it seems to us there would be no false pretences, nobody would expect more than he should receive, and every workman would be protected for a long period to make it an object to do his best, to become dexterous and to use his inventive faculties as well. Such a transaction would, at least, be business-like, and the piecework system thus managed would in effect be a piecework-premium system.

ANNOUNCEMENT.

Mr. Clarence P. Day has resigned the Vice-Presidency of The Industrial Press and retires from his connection with its publications on December 12th, for the purpose of engaging in a unique profession—that of Advertising Counselor. Mr. Day's new departure should not be classed with advertising agencies or brokers, as it is entirely separate and distinct, and he purposes giving different service from what is offered by any agency. In this position, his eighteen years' experience in their field will enable him to offer mechanical advertisers who are seeking the most effective results from their advertising, services which should be of great value to them in securing the most effective results from their outlay.

Mr. Day's preliminary announcement appears in another column of this paper, and we feel sure his many friends will join with us in wishing him unqualified success in his new undertaking.

* * *

NOTES AND COMMENT.

Our attention has been called by Mr. Arthur to two errors which appeared in his article on the Remontoir Clock, published in the November number. On page 72, left-hand column, the ninth line from the bottom should read: "downwards, because brass has less than *twice* the rate of steel." On page 73, left-hand column, the thirtieth line from the top should read: "regular depth. Mesh these gears *fifteen-sixteenths* the usual depth."

Ezra Gould, the founder of the firm of Gould & Eberhardt, Newark, N. J., died in that city on November 2, aged ninety-three years. Mr. Gould retired from business about ten years ago, but it is said that he occasionally paid visits to the works. He learned the machinist's trade at the Rogers Locomotive Works, Paterson, but later he moved to Newark and engaged in the machine tool business, which has been the work of the shop ever since. Mr. Gould was one of the first to build milling machines and gear cutters in this country.

From May to September, 1902, there is to be an exhibition at the Crystal Palace, London, England, of exclusively American products, arts, industries and inventions. This, it is stated, will be the largest and most important of its kind ever seen in the United Kingdom. As the year 1902 will be marked by the coronation of King Edward VII, no more auspicious time and place could have been selected for an exhibition, as the historical event to take place in London will draw to that city a great number of visitors. A commercial bureau will be established under the direction of a committee of representative American and British firms, where information will be supplied regarding channels of trade, and the placing of goods upon the British and Continental markets. Any particulars regarding the exhibition can be had by applying to Alfred H. Post & Co., Produce Exchange, New York.

CONVEYING ENERGY FROM THE COAL MINE.

There is a great deal of talk of doing away with the present expensive and wasteful method of mining coal and transporting it to market by railways. The electricians are predicting that it will be done away with in time and that huge power stations will be located in the near vicinity of the mines and electric energy transmitted to great cities by high-tension currents. While this seems an ideal condition now, it is certainly not impossible and will undoubtedly be found less expensive for power than the present system. The great difficulty, however, is that a large part of the coal annually burned, is for heating purposes. The use of electricity for heating is hopeless with any present known apparatus for transforming the energy of coal into electrical energy. The losses by electrical heating are enormous, the efficiency being less than ten per cent. This being the case, it would appear that the best practical method of getting coal, or rather its product, to market will be by pipe lines, and in the form of gas. While gas which has been under heavy pressure is not well adapted to lighting in ordinary gas burners, it is an ideal fuel and can be utilized for power in gas engines with fully as economical results in many cases as electricity and electric motors. The cost of pipe lines would be heavy, but the cost of operation is very low.

John A. Johnson, late president of the Gisholt Machine Co., Madison, Wis., died at his home in Madison on November 10. Mr. Johnson was a native of Norway. His parents came to America when young Johnson was but 12 years old, and as a boy he worked on a farm and later sold farm machinery, and in 1862 he started in the implement business with Mr. M. E. Fuller, under the firm name of Fuller & Johnson. It is said that the large line of implements manufactured by the firm was for the most part the product of his inventive genius. Many of his inventions have been patented. About ten years ago Mr. Johnson organized the Gisholt Machine Co. for the manufacture of lathes, in which they have been very successful, the Gisholt lathe being well known. His four sons, all of whom were machinists, were associated with their father in his new enterprise. For some time past the management of the Gisholt plant has been entirely in the hands of the sons of Mr. Johnson, owing to the father's poor health, and there will be no break in the Gisholt plant by reason of Mr. Johnson's death. The Gisholt Company received its name from the city of Gisholt in Norway, the birthplace of Mr. Johnson.

DE LAVAL TURBINE.

The steam turbine as a prime mover for general purposes promises to soon become a formidable rival to the reciprocating steam engine. The Parsons steam turbine is being built in the United States by the Westinghouse Machine Company, East Pittsburg, Pa., and the De Laval Steam Turbine Company are preparing to build the De Laval steam turbine on an extensive scale. They have built new machine shops at Trenton, N. J., which will be equipped with the best modern machine tools and appliances for economical manufacturing. The main shop building is of saw-tooth side and center nave construction which is unsurpassed for light. It will be equipped with electric traveling cranes and the machine tools will be electrically driven. Some of the machine tools are very costly, being of special design, especially the spiral gear cutting machines built for the company by the Pratt & Whitney Co. Spiral reducing gears are used in the De Laval turbine for reducing the rotative speed of the driving shaft, as the speed of the turbine wheel is too great to allow it to be directly connected for almost any purpose except that of driving centrifugal separators. Hence the desirability of gear cutting machines of the highest attainable perfection of product to produce noiseless gears.

A. S. M. E. MEETING.

The forty-fourth meeting of the American Society of Mechanical Engineers will take place from Dec. 3 to 6 in the society's headquarters, No. 12 West 31st Street, New York. The following are the subjects that will be discussed at the various sessions:

Opening Session, Tuesday evening, 3rd: Annual address by President Samuel T. Wellman, the title of which will be "Early History of Open-hearth Steel Manufacture in the United States."

Second Session, Wednesday morning—"Cost of Running Trains at High Speed." "Some Peculiarities of Springs." "The Linvolpon System of Units."

Thursday morning—"A portable Accelerometer for Railway Testing," by F. B. Corey. "A Bonus System of Rewarding Labor, by H. L. Gantt. "A Silent Chain Gear," by J. O. Nixon. "The Bursting of Small Cast-iron Flywheels," by C. H. Benjamin.

Third Session, Thursday evening—"A New Valve Gear for Gas, Steam and Air Engines," by E. W. Naylor. "The Potter Mesh Separator," by F. A. Scheffler.

Closing Session, Friday morning—"Working Loads for Manila Ropes," by C. W. Hunt. "The Heat Engine Problem," by C. H. Lucke. "Experiments on Spiral Springs," by C. H. Benjamin and R. A. French. "Water Power Development at Hannawa Falls," by W. C. Johnson." "The Porro Prism," by W. R. Warner. "Effect of Clearance on the Economy of a Small Engine," by Albert Kingsbury.

FELLOWS RACK SHAPER.

The Fellows Gear Shaper Co., Springfield, Vt., are now manufacturing a rack shaper which operates on the same principle as their gear shaper, although the mechanical movements of the machine have been worked out on somewhat different lines, owing to the different requirements of the case.

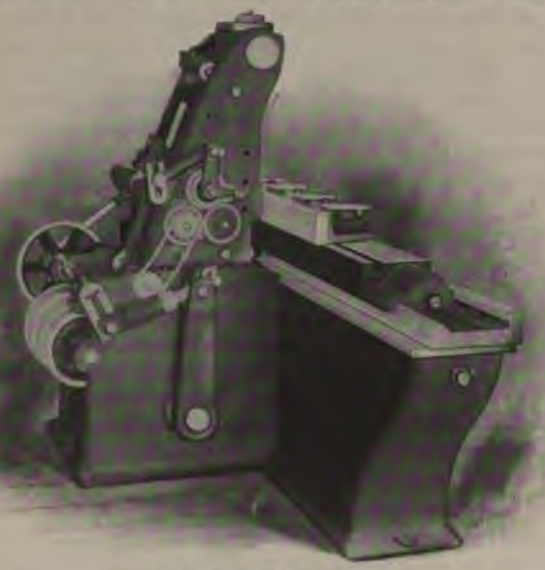


Fig. 1. End View of Shaper.

A rack cutter on this principle has been in operation at Springfield, Vt., for some time, thus giving ample opportunity to perfect the machine and to thoroughly test it before placing it on the market.

The Fellows gear shaper is familiar to most of our readers, but a brief explanation of the principle of its operation will not be out of place and will be of assistance in the explanation of the rack shaper. In the former machine the cutting tool is an accurately formed gear wheel of tool steel, with the teeth properly backed off. The cutter is carried by a cutter bar, which moves in a vertical direction and is supported by a carriage, which travels in a horizontal direction on a cross rail. The gear blank is supported on a vertical arbor and the cutter is fed into it to the depth of the tooth, this distance being determined automatically; and then the cutter and blank revolve at the correct relative speed, and the teeth are thus formed upon the well-known principle that a gear tooth can be made to shape its conjugate in a blank running in correct relations to it. But one cutter is required for any wheel of a given pitch within the machine's capacity. As this is ground accurately after it is hardened, the work cut by it is of necessity accurate and should run correctly with any other gear made by the machine, even though the diameter of the blank is not exactly correct.

The rack shaper operates upon the same principle as the gear shaper, using the same cutter. For the rotary motion of the gear blank is substituted the straight-line motion of the rack blank. During the return stroke of the cutter it is, of course, necessary that the blank and the cutter should be separated slightly to prevent the destruction of the cutter by wear. In the gear shaper this is accomplished by a slight movement of the blank, but in the rack shaper the cutter and cutter slide are the parts that are moved. It will be seen from the engravings that the cutter slide is suspended upon trunnions, which allow the entire slide to have a limited swinging motion. The lower end of this slide bears in an auxiliary guide marked *D* in each of the three views on the opposite page, and the position of which guide is controlled by a cam-actuated lever. The faces *F* of this auxiliary guide, seen in the plan in Fig. 5, are held rigidly against an inner face of the main frame, during the downward or cutting stroke of the cutter slide. The auxiliary guide, together with the main frame, thus forms an ordinary slide bearing for the cutter slide. During the return stroke of the cutter the auxiliary guide carrying the cutter slide is withdrawn from the blank an amount sufficient to prevent the rubbing of the cutter.

The rotary motion is transmitted to the cutter slide through an inclined shaft *S*, Fig. 3, which operates a worm and wormwheel at the upper end of the spindle through bevel gears. The connection between the spindle and the wormwheel is through a semi-circular slide so designed as to prevent lost motion at this point, this slide being the same as used in the more recent designs of the gear shaper.

The reciprocating motion of the cutter slide is obtained through a driving crank which actuates a bell crank, which in turn connects with the cutter slide by a pitman, shown in Fig. 3. In the same figure the location of the feed screw for the table is indicated, and also the connection between it and the mechanism for rotating the cutter spindle, so that the movement of both will be in unison. The rotary motion is transmitted to spur gear *B* through bevel gears and shafts. This gear connects with gear *C*, giving the nut of the feed screw a rotary motion. This feed motion is reversed by tumbler gears.

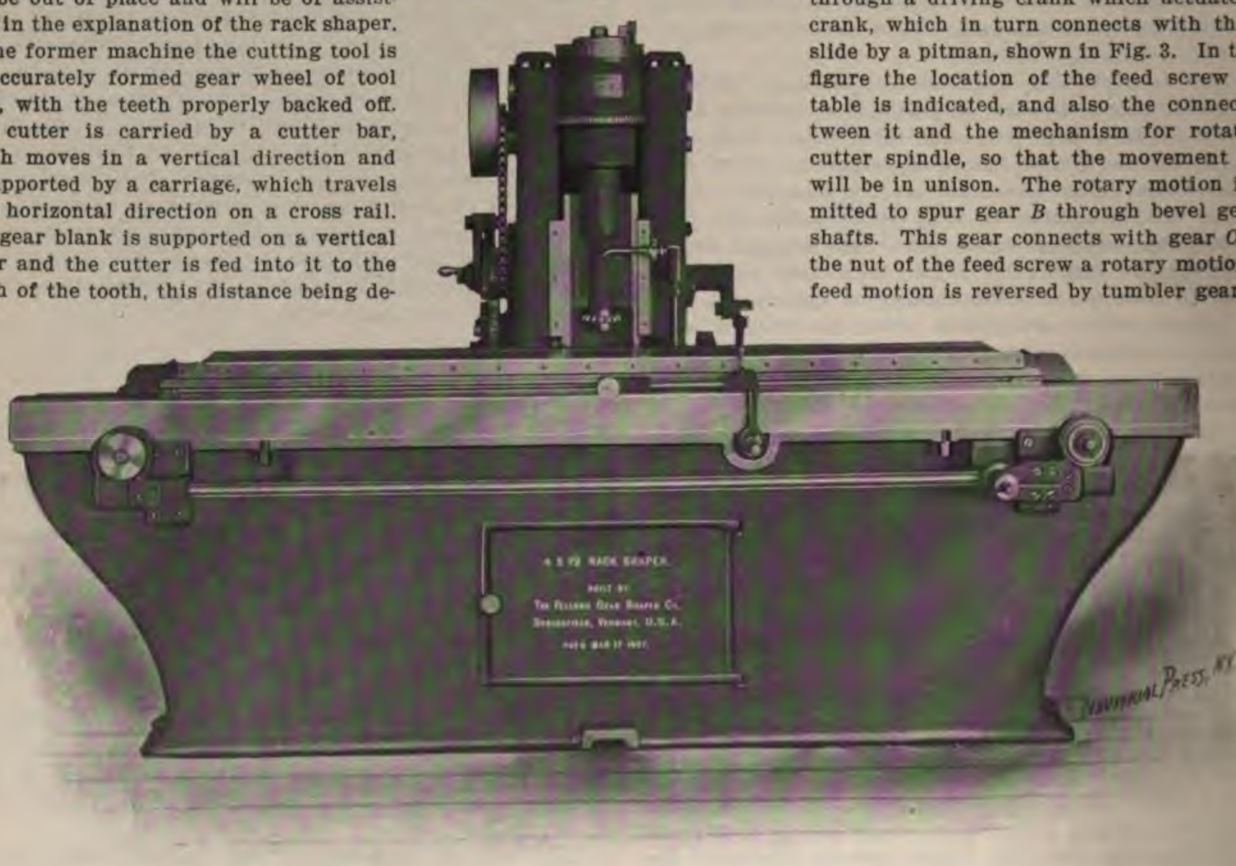
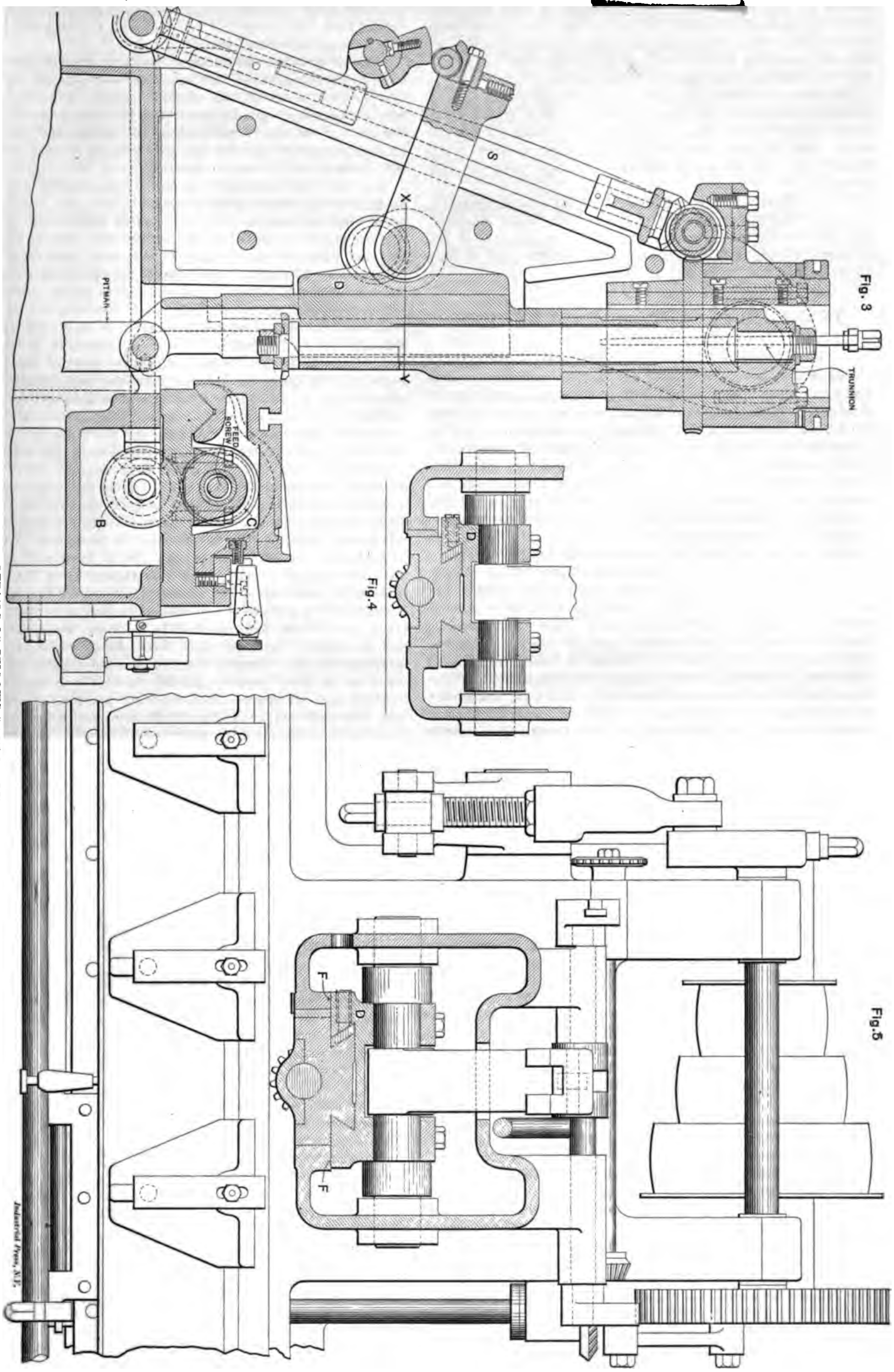


Fig. 2. Front View of Shaper.

It is recommended that in using the machine the feed be reversed after cutting a set of blanks, and the next set cut by running the platen in the opposite direction. This saves returning the platen to the starting point at each operation. Mechanism is provided by which the feed can be tripped at any position of the platen in either direction. A power quick



DETAILS OF FELLOWS GEAR SHAPER.

return of the platen in either direction is also provided. Depth adjustment is controlled by the two short screws seen in the plan. These screws are operated by hand in unison by the rod extending across the front of the machine. A graduated dial indicates the depth in thousandths.

The blanks are held by a system of clamps which are removable, permitting any form of blank to be operated upon, as in cutting a rack upon a heavy slide. These clamps are seen in the end view and plan, but have been removed in the front view. An oil pump and the necessary pans are also provided.

One peculiarity of this machine is that no change gears are required. As the cutters all have the same pitch diameter, they all roll in unison with the blank. The capacity of the machine is from 16 to 5 diametral pitch inclusive, and is built in lengths of 5, 6, 8, 10, and 12 feet.

* * *

THE ANNUAL AUTOMOBILE EXHIBIT.

AT MADISON SQUARE GARDEN, NEW YORK.

The second annual exhibit of automobiles, automobile parts and accessories under the auspices of the Automobile Club of America, was held at the Madison Square Garden in New York from November 2 to 9. It was a successful show both as a demonstration of the development and improved construction of the automobile and in the number of machines sold. The sales were estimated to be nearly $2,000,000, which if one-half true shows the present importance of the industry and is fair indication of what will be its importance in the near future.

Nearly 150 machines were exhibited on the main floor of the Garden by the various manufacturers and in the restaurant room attached were shown about 25 machines loaned for the occasion by the club under whose auspices the exhibit was held. The type of automobile most in evidence was that driven by internal combustion motors. Next in importance were the steam driving machines and the electric machines were naturally in the minority because of their limitation to localities furnishing electric energy. Practically all of the racing machines shown were of the gas engine type, and almost all follow the style of the French machines, the variation from pure imitation being more in the matter of detail than in general design. These formidable road locomotives have multi-cylinder engines, four cylinders being not uncommon and some having six cylinders, as in the case of the Winton racing machine, which has a six-cylinder gas engine of 40 H. P. The famous Fournier machine, which has a six-cylinder engine of 60 H. P., was also shown on the main floor. This machine has made road records of nearly one mile per minute. The complication of machinery because of so many cylinders is preferred to the excessive vibration which appears inseparable from machines having one- or two-cylinder engines.

While the attention bestowed on the racing automobile may result in developing the ordinary types, it is in general to be deplored since the future of the industry is not in building racers or pleasure machines so much as it is in the automobile for more utilitarian purposes. At present, however, there is no doubt that the first two types are the most profitable. since scarcely enough has been done in the development of the motor-truck to merit serious attention. But the future of the automobile is, in the opinion of most conservative observers, that of a burden-carrier as it will in this capacity serve the best and greatest interests. The displacement of the horse from city streets and the facilitating of freight moving by its general use, would transform dangerous and nerve-racking highways of confused traffic in great cities into boulevards of commerce on which freight as well as pleasure vehicles move noiselessly and swiftly.

The manufacture of steam-driven machines seems to be along more conservative lines, and the machines are more purely of American design. Because of its simplicity and reliability, the steam automobile is as much of a general favorite as it is because of lower price. It is not so noisy as the gas-engine machine, and is freer from vibration, two quite essential requirements for a pleasure vehicle. A great deal of criticism has been made of the automobile because of its being a copy of the horse-drawn vehicle with the horse left off. The steam machine exhibit showed a general tende depart from this alleged defect, although it was quite able in some individual cases.

Without question the electric machines shown were trim in appearance and the smoothest and quietest ru The present state of the storage battery, however, giving promise of greatly extending the radius of act the electric vehicle, is not such as to warrant the use ectric machines except for city use, keeping always wi safe distance of the base of supplies.

The exhibit of automobile parts and accessories wa as interesting as the complete machines, if not more many visitors. Among the new things in the gearing li the Brown-Lipe equalizing gear, which does with spur nal and external gears what the ordinary form does bevel gears. The advantages claimed for this device a it is cheaper, wears longer, and wastes less power by f

Noiseless gearing is naturally very desirable for a biles, and for this reason the exhibit of the New I Rawhide Co. attracted attention. A practical dem tion of the difference in the noise produced by two gears running together, and one metal and one rawhide was made by a model consisting of a large gear driven electric motor through two pinions mounted on the same One of the pinions was of cast iron and the other of ra With the former in mesh with the large gear, the nois considerable, although the gears were machine cut, with the rawhide pinion in mesh the noise was imperce

An automobile is as dependent on good tires for succ a bicycle and is of course much harder on them because far greater weight. The development of pneumatic tir automobiles, capable of supporting 800 to 1,000 pounds and still be resilient and almost puncture-proof, is one remarkable features of the industry. It would natura thought that a three-inch tire with walls one inch thick ing a space for air only one inch in diameter, would be and unyielding, but such tires were shown which we markably elastic. Bicycle tires of similar constructio made by the same company, having one-half inch walls one-half inch air space. Such tires are practically pun less, and while not as resilient as thinner wall tires, th so reliable as to specially commend themselves to use quiring a most reliable tire. The price is high, being $7 apiece.

The exhibits of seamless tubing and seamless boiler were specially interesting as were also the automobile boilers. They were mostly of the fire-tube type, the being seamless and the tubes copper or of steel coppere to prevent corrosion. The tubes, usually about one-hal in diameter, are crowded as closely together as possil that in a boiler 16 inches in diameter as many as 350 may be found. Such a steam boiler designed to carry a pressure of perhaps 200 pounds per square inch and velop six or eight horse power in a space of, say, two feet, is a feat of engineering.

Among other features of the show, the abandonment steel wire spoke wheel and the general use of the wheel was at once apparent. While the steel wire wheel was specially adapted to the bicycle, it has been strated not to be so for the automobile, because of side which, of course, is not borne by the bicycle wheel.

* * *

Electricians will be greatly edified by the following tific explanation of "why our feet get cold" as perpetr the advertisement of an "electric" insole. "In the first the human body is an electric battery, the upper half positive and the lower part negative. The earth on we stand is a powerful magnet. In damp or cold w the moist or cold earth attracts the electricity from th which is taken up by the magnetic globe on which we thus depleting our bodies by extracting from them th tric forces or currents which keep the blood in motion. it is that our feet become cold for want of circulati we run, jump or dance, the molecules of blood by stim and attrition, vibrate among themselves, such vibratio the source of electro magnetic heat, whether in the foo the brain," etc.

3 FROM THE METROPOLITAN STREET RAILWAY POWER STATION.

stallation of the eleven engines and generators at Metropolitan Street Railway power station at Ninety-set and East River, is slowly nearing completion. now in running order eight of the Allis 5,000 horse rtical compound condensing engines driving General lternating generators of 3,500 kilowatts each. Two ines and generators are in process of erection, and will follow directly as they are being finished.

ht completed engines have simultaneously carried a arly 38,000 horse power without trouble. Aside from of the alternators, due to the molecular vibrations mature and field coils, there is scarcely any per-noise from the operation of the huge engines and s, while each unit is developing and transforming rical energy nearly 5,000 horse power.

ection of the engines is an interesting process on of the magnitude of the work. The hollow steel one weigh about 74,000 pounds, and the flywheels 000 pounds each. To this enormous weight borne earings must be added that of the revolving fields, g rods, crossheads and pistons. Although the shaft es in diameter and made of fluid compressed steel, ceptibly deflected by the enormous weight carried. tible is the deflection, that the erectors throw the xis of the cylinders out of plumb about one-eighth he height of the engines. By doing this the con-od brasses are made to bear squarely on the pins, course, would not be the case if the engines were ly plumb under the conditions named. That these e able to bear such loads for an indefinitely long service during which time they are perceptibly and forth millions of times, is a striking testi-their integrity and spring-like qualities.

the erection of the engines, a new feature of pis-ruction has been adopted, and all the pistons have d in the same manner. Each of the pistons has ing ring, set out by springs. The high-pressure made in two parts, the joints being fitted with pers to prevent leakage. The feature of construc-red to, Fig. 1, is that the bull-ring is made integral follower plate instead of the two being separate as he bull-ring and follower thus form an inverted cup 6 inches in diameter, with a large hole in the top. ring and follower are held to the steel piston by rge screws, whose heads are set flush with the f the follower face. Screw holes for eye-bolts are for removing the combined follower and bull-ring cylinder. To examine the packing the twelve bolts ved and the bull-ring removed without disturbing

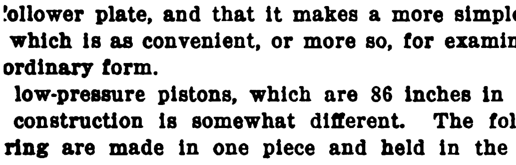


Fig. 1. Combined Follower and Bull-ring.

n. The bull-ring abuts against a flange on the pis-asbestos gasket being interposed to prevent leakage. antages of this construction are that there is no or the bull-ring to work loose between the piston follower plate, and that it makes a more simple con-which is as convenient, or more so, for examination ordinary form.

low-pressure pistons, which are 86 inches in diam-construction is somewhat different. The follower ring are made in one piece and held in the same The packing ring, however, is placed near the top f in the center of the bull-ring, and a narrow ring holds it in position. The follower ring acts as a to the follower bolts, being set so close to them heads must all be turned with a flat next the ring. s construction, the packing ring may be examined removing the bull-ring, by taking off the narrow follower ring referred to. This construction is undoubtedly stronger than a solid cast iron piston would be, and it avoids the bad-wearing qualities of an all-steel piston.

To easily get the high-pressure cylinder bull-ring into the cylinder with the packing in place, Mr. Tomlinson, the assistant chief engineer, has a useful kink. A thin steel band made in two parts is placed around the bull-ring so as to cover about one-half the upper width of the packing ring. The band is drawn together snugly on the packing by nuts on the screws holding the two parts of the band together. In this manner the packing is easily forced into the bull-ring so as to be flush with the surface. When being lowered into the piston, the band is removed as the packing enters the counterbore. The packing is thus started with none of the pushing and prying against the packing, which is both dangerous and trying when on top of a vertical engine cylinder at a distance of forty feet from the floor.

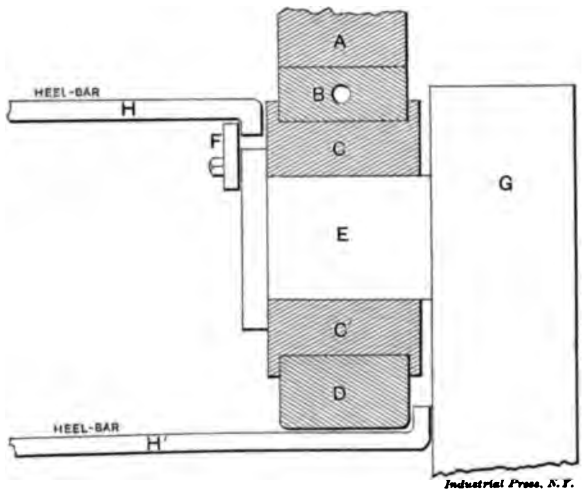


Fig. 2. Adjustment of Crank-pin Brasses.

The manner of adjusting crank-pin brasses of such large engines is not without interest, since obviously somewhat different means must be taken to do it nicely than on small engines with which most engineers are familiar. The ordinary process of screwing up the adjusting wedge and pushing the connecting-rod back and forth on the pin by hand to test the adjustment is scarcely practible when the weight on the pin, as in this case, is not far from fifteen tons. Yet essentially the same procedure is gone through by the aid of simple mechanical aids to move the rod sideways on the pin. Each pin is drilled and tapped in its face with two 1-inch holes. These holes are for screws for holding the piece *F* in Fig. 2 to the face of the pin when adjusting the brasses. The holes are ordinarily filled with two flush-head screws for the sake of a neat appearance. The piece *F* forms a fulcrum for a heel-bar *H* to force the connecting-rod inward on the pin. To throw it outward another heel-bar *H'*, is inserted between the strap *D* and the crank-disk *G*. The adjustment is made by screwing the wedge *B* between the end of the connecting-rod *A* and the brass *C* in the usual manner. Helpers on the end of the upper heel-bar *H* throw the connecting-rod inward, and the engineer attending to the adjustment throws it outward with the heel-bar *H'*. After reaching the limit of adjustment at which the rod can be comfortably moved back and forth by the heel-bars, the wedge is slacked back such an amount as the engineer's judgment decides will be sufficient for cool running.

To prevent the wedges rusting so as to move very stiffly, as they will often do, even when deluged in a bath of oil, four shallow oil grooves are cut across both faces bearing against the rod end and the brass. The oil grooves allow the oil to get to the faces and prevent them rusting to any great extent.

The adjustment of the brasses on the crank-pin and on the crosshead-pin, is made both for the high- and low-pressure sides with the crank-pin at the top center. The engine is turned over by hitching a chain around a spoke or the rim of the flywheel and engaging with it the hook of the 30-ton Sellers traveling crane, which serves the entire floor space. In this manner the engine is slowly turned over by power and stopped at any point wanted.

LETTERS UPON PRACTICAL SUBJECTS.

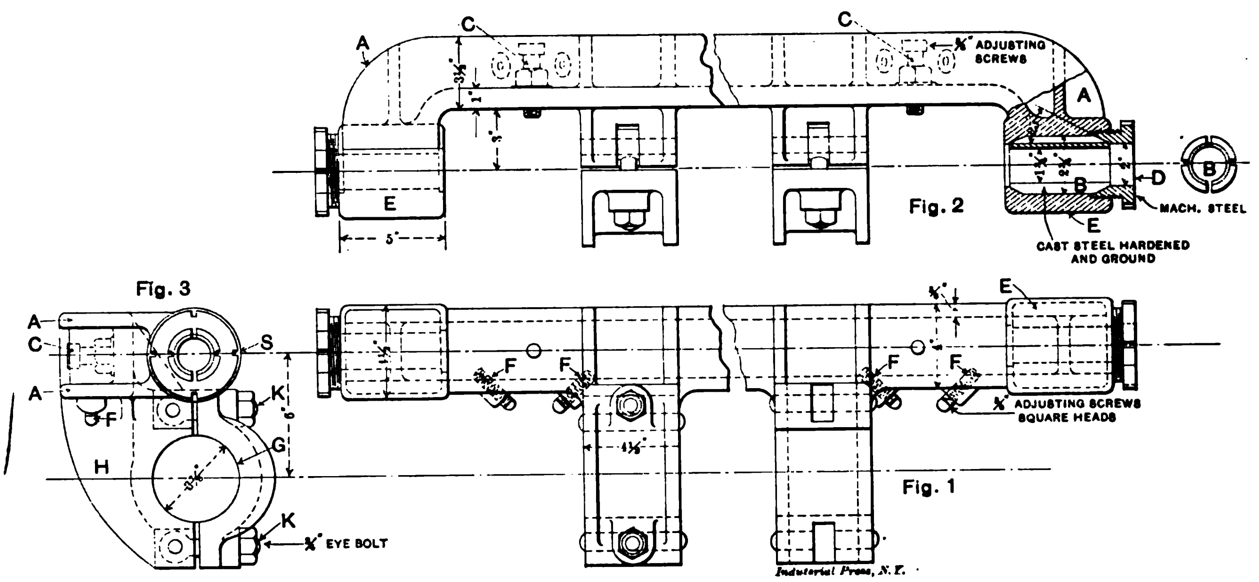
JIG FOR BORING CRANK-PIN HOLES.

Editor MACHINERY:

The accompanying cuts illustrate a jig designed for boring crank-pin holes in flywheels, as used on donkey pumps, straight-line air-compressors, etc., where there is a flywheel on each end of the shaft and a rod connects the crosshead with a pin in each flywheel. It is very important in cranks of this character that both pins have precisely the same throw and that there be no advance of one pin over the other, as otherwise there will be brought to bear upon the crosshead connections a bending effect which will cause trouble by binding, etc.

Another commendable feature connected with the adjustable bushing is the facility with which it may be replaced by another of different size, thus allowing bars of various diameter to be used, with the advantage at the same time of close working fits between bars and bushings. This frequently becomes necessary in work of this character when the stock in the holes to be bored is too great or when the holes are out of line to such an extent as to prohibit the regular bar being used. Two or three sets of bushings can be made, with different sized holes, to suit the requirements.

The adjusting screws *C C*, Fig. 2, and *F F*, Fig. 1, are to be



Details of Boring Jig.

set out against the hubs of the cranks and the arms of the wheels, respectively, after the jig has been set in its proper position, which effectually prevents any twisting of the jig upon the shaft and obviates the necessity of putting any great strain upon bolts *K K*, Fig. 3.

In making the jigs for the various sizes one of the principal things that had to be kept in mind was that the maximum rigidity must be secured; at the same time, however, the weight should be no greater than necessity demanded on account of handling. But under no circumstances should too little metal be put into any jig in the endeavor to reduce the weight, even if the conditions demand it; for if that is done the probabilities are that sooner or later it will have to be added in the form of patches or perhaps of an entire new jig. Figs. 1, 2, and 3 show three views of the jig, which is, as drawn, intended for a machine with a stroke of 12 inches.

The webs of the frame *A* and *H* are made quite deep, and the bearings for the boring bar are made abundantly long, as they have much to do with the securing of a good hole. The usual solid bushing has been dispensed with as being unreliable and the one shown in section in Fig. 2 used in its stead. This construction is slightly more expensive to build than the solid bushing, but is so far superior to it that the increased cost need hardly be considered. The hub *E* is bored and reamed, and then the bushing *B* is turned up, after which four slots are milled in its outer surface lengthwise, as shown, one slot going all the way through the shell, while the remaining three go within about one-eighth inch of the bore. The bushing is then hardened and ground to slide into the hole in the hub *E* with about .002-inch clearance. A feather, not shown in the drawing, is fastened permanently in the hub to prevent the bushing from turning and is made to slide freely through either of its four slots, thus making it immaterial which way the bushing is placed in the hole and also allowing for preventing unequal wear. The nut *D* might have been made of cast steel if desired, but machining steel answers very well, however. Four slots were milled in its flange to receive a spanner for turning it, as shown at *S*, Fig. 3. When the boring bar is placed in position in the bushing the nut is turned in against the bushing until a slight friction is felt on the bar when turning it by hand. This, of course, does away with all play between the bar and the bearing, with its consequent chatter.

Fig. 4 shows the method of fastening the cutters in the boring bar. The pin *I* is made of cast steel turned to a taper of ½ inch to the foot and hardened. The front edge of the cutter is so placed that it will cover about one-half of the diameter of the pin hole, and the part of the cutter that covers the hole filed away almost entirely, leaving just sufficient stock for the pin to press against when it is driven in

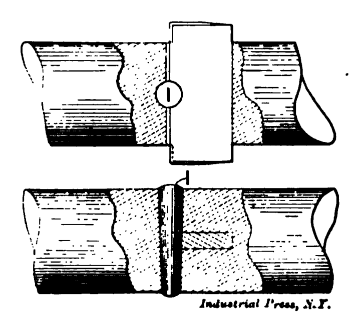


Fig. 4.

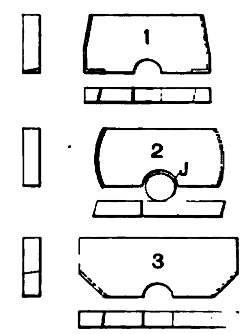


Fig. 5.

tight. The cutters are turned while in this position, then taken out, hardened, replaced and ground to size. A number can be made at one time and kept in stock, being first carefully marked.

Fig. 5 shows a set of cutters for boring a hole. No. 1 is the roughing cutter and is held in the bar in the manner shown in Fig. 4. Two rough cuts should be taken, and consequently two roughing cutters will be required for each hole, the second cutter leaving about .025 inch for the finishing cutter. The finishing cutter, No. 2, which is of the form shown with rounded cutting edges, can be left loose in the bar. It is placed in the same slot as cutter No. 1, but the semi-circular groove *J* in it is enlarged so that when the

cutter is in its proper place the pin does not come in contact with it, the pin being used in this case merely to prevent the cutter falling out of the bar previous to its entering the hole. Cutter No. 3 is used for countersinking the holes, which should be done before the finishing cut is taken. It is held in the bar in the same manner as cutter No. 1.

There are several methods of applying power for operating.

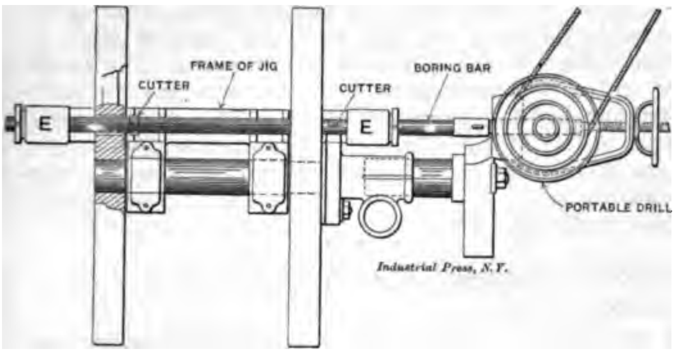


Fig. 6. Method of Driving the Bar.

A universal drill is a good driving mechanism in so far as power and feed are concerned, but as a rule drills of this character are kept busy on other work. A very good arrangement is that shown in Fig. 6. It consists of a rope-driven Dallett portable drill, attached to the boring bar direct. The method of attaching is already shown in the cut, the drill being bolted against the finished hub of the wheel in such a position that its spindle is brought in line with the boring bar . It does the work admirably and can be set in almost any out-of-the-way place when rope-driven. This is especially true if the drill be motor driven. S. B. McQuade.

Montreal, Canada.

* * *

SMALL INSIDE MICROMETER CALIPER.

Editor Machinery:

The accompanying sketch, Fig. 1, shows an inside micrometer caliper of my design which measures from 1 inch to 2½ inches, and has ¼-inch adjustment of screw. The external view, shown at *I*, Fig. 1, is full size, but the sectional view, Fig. 2, is enlarged to three times the actual size to better illustrate the details. *A* is the frame carrying the adjustable screw *O*, and *E* is the main screw which carries the barrel *B*.

Provision is made for the taking up of any wear that may occur in all necessary places. The wear of the nut and screw is taken up in the way commonly used in outside micrometers, that is, by turning the small nut *N*, Fig. 2, on the tapered end of the split bushing *O*. The contact piece *D* passes through the shell *B* and screws into the main screw *E*.

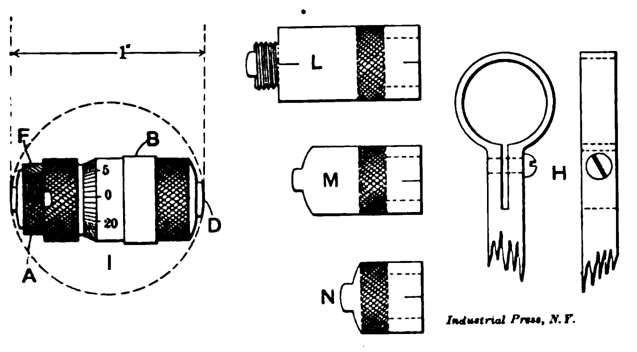


Fig. 1. Inside Micrometer.

holding them all together firmly, and there are two small flat spots on the head of this piece *D* so that a wrench can be applied to loosen it if it desired to rotate the barrel *B* on the screw *E* to bring reading line correct when adjusting for wear on contact piece *D*. As both contact pieces are hardened on their ends, wear is, of course, very slight.

The contact piece *C* screws into the frame *A* and is provided with a small taper headed screw *S*, which locks it firmly in position when screwed up, the end of *C* being split. The extension contact pieces *L*, *M* and *N*, Fig. 1, are all provided with this adjustment and screw onto the frame *A* up to a shoulder, there being a line on the extension piece and on the shoulder to show when it is up to its proper place. This line is shown on each of the extension pieces, *L*, *M* and *N*, in the drawing, and also on the small sketch of the micrometer at the left-hand end of its frame *A*.

The largest, or ¾-inch extension piece, is threaded on its outside end to the same size as the micrometer frame at *T*, allowing the ½-inch, or ¼-inch, extension pieces to be screwed onto it, thus making the capacity of micrometer 2½ inches. With this form of extension piece the operator does not need to use a magnifying glass, as is usually the case with other kinds, in setting rods to a line. The threaded portion of the frame at *T* can be covered with the small bushing *F*, shown in sketch, Fig. 1, when extension pieces are not being used.

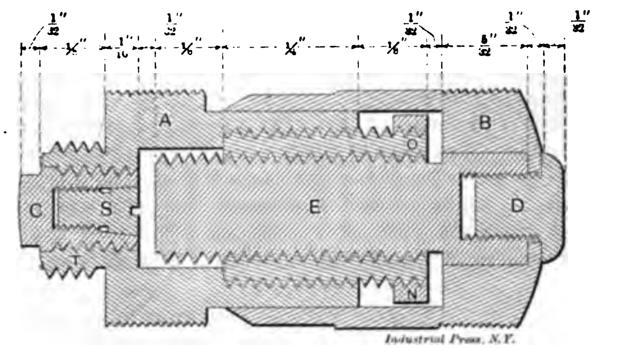


Fig. 2. Section of Micrometer Enlarged Three Times.

There is 1-32-inch clearance at both ends of the screw *E*, allowing the micrometer to close to 31-32 inch, and when out to its full extent there is ¼ inch of the screw in the nut *O*. The handle, shown at *H*, Fig. 1, is for use in deep holes, being clamped over the enlarged portion of the barrel *B* near its middle. M. H. Ball.

Watervliet, N. Y.

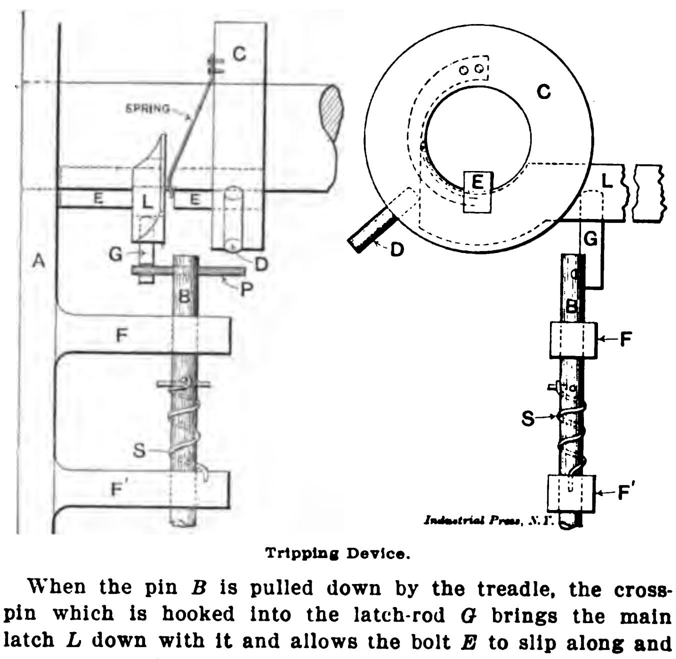
* * *

POWER PRESS TRIPPING MECHANISM.

Editor Machinery:

The accompanying sketch shows a tripping mechanism for a power press, the use of which makes it impossible for the gate to come down twice, even if the operator holds the treadle down.

A, in the cut, represents the side of the press, from which the two lugs *F F'* extend out. These lugs have the round pin *B* sliding through holes in them, and the spring *S* on the pin is so arranged as to hold it up and also to keep it turned around to the left so that the cross-pin *P* in its upper end is held against the latch-rod *G*.



Tripping Device.

When the pin *B* is pulled down by the treadle, the cross-pin which is hooked into the latch-rod *G* brings the main latch *L* down with it and allows the bolt *E* to slip along and engage in a clutch, causing the gate to come down. But as the collar revolves with the shaft, the pin *D* on the collar *C* comes around and strikes the cross-pin *P*, thereby throwing it out of the notch in the latch rod *G* and allowing the latch *L* to go back to the normal stop position.

When it is desired to operate again the treadle is raised by lifting the foot and the cross-pin *P* hooks into the latch-rod *G* again. In piercing the pin *D* is removed entirely, which prevents the constant tripping of the latch.

W. W. Cowles.

Waterbury, Conn.

* * *

FIXTURE FOR MILLING LAG-SCREW THREADS

Editor Machinery:

The accompanying cuts, Figs. 3, 4 and 5, represent a fixture used for milling lag-screw threads, as shown in Fig. 1, upon blanks as shown in Fig. 2, the finished pieces being for use on the spindles of jewelers' small polishing lathes to hold buffing wheels and scratch brushes. As it was not desired to center the blanks, and as there was considerable metal to remove, it was thought advisable to mill them rather than to cut them in the lathe.

The fixture consists of a spring chuck *C*, mounted on a slide *S*, which is capable of motion along ways on its base *B*. The slide is given its advancing motion along the ways by a leadscrew *L*, which is driven through the gear and pinion *G* and *P* from the shaft *A*, and at the same time the lead screw gives the chuck its rotary motion through the pinion and gear *p* and *g*, Fig. 3, *p* being feathered to the lead screw so as to be able to move along with the slide as it advances. The gear *g* is made as an integral part of the spindle which holds the spring chuck, the nut *N* on the end of this spindle being for the purpose of tightening or closing the chuck, as well as to hold the thin washer *W*, which keeps the pinion *p* in mesh with its gear while the slide is traversing. The axis of the spindle is, as shown in Fig. 3, inclined at an angle of 4½ degrees to the horizontal to allow for the taper of the screw. The long ⅝-inch shaft was driven from the feed of the milling machine through a universal joint fastened to it at the end *A*, and the required rate of feed of the blank per revolution of the cutter was properly determined by the ratio of the gears *P* and *G*.

In order to take a sufficiently deep cut to finish the screws at one cut, it was found necessary to support the blank by a suitably shaped steady-rest placed under it to bear the thrust of the cut, but it was found that a stop was unnecessary, because as soon as the slide reached the end of its traverse the resistance of feeding further would cause the feed belt to begin to slip, thus making it impossible for the cut to be carried too far. When the cut had been finished the machine was stopped and the table lowered, and the screw removed from the chuck. Then the pinion *P* was slipped out of mesh with the gear and the slide returned, by rotating the leadscrew by hand, to its original position ready for another blank. The cutter was made especially for this work, the required shape of thread being obtained by a little experimenting. The fixture was, of course, fastened on the table with the leadscrew nearly in line with the spindle of the milling machine, being set out of line with it only to an angle equal to the obliquity of the threads of a 4-pitch screw, so as to provide clearance for the cutter.

H. J. Bachmann.

New York City.

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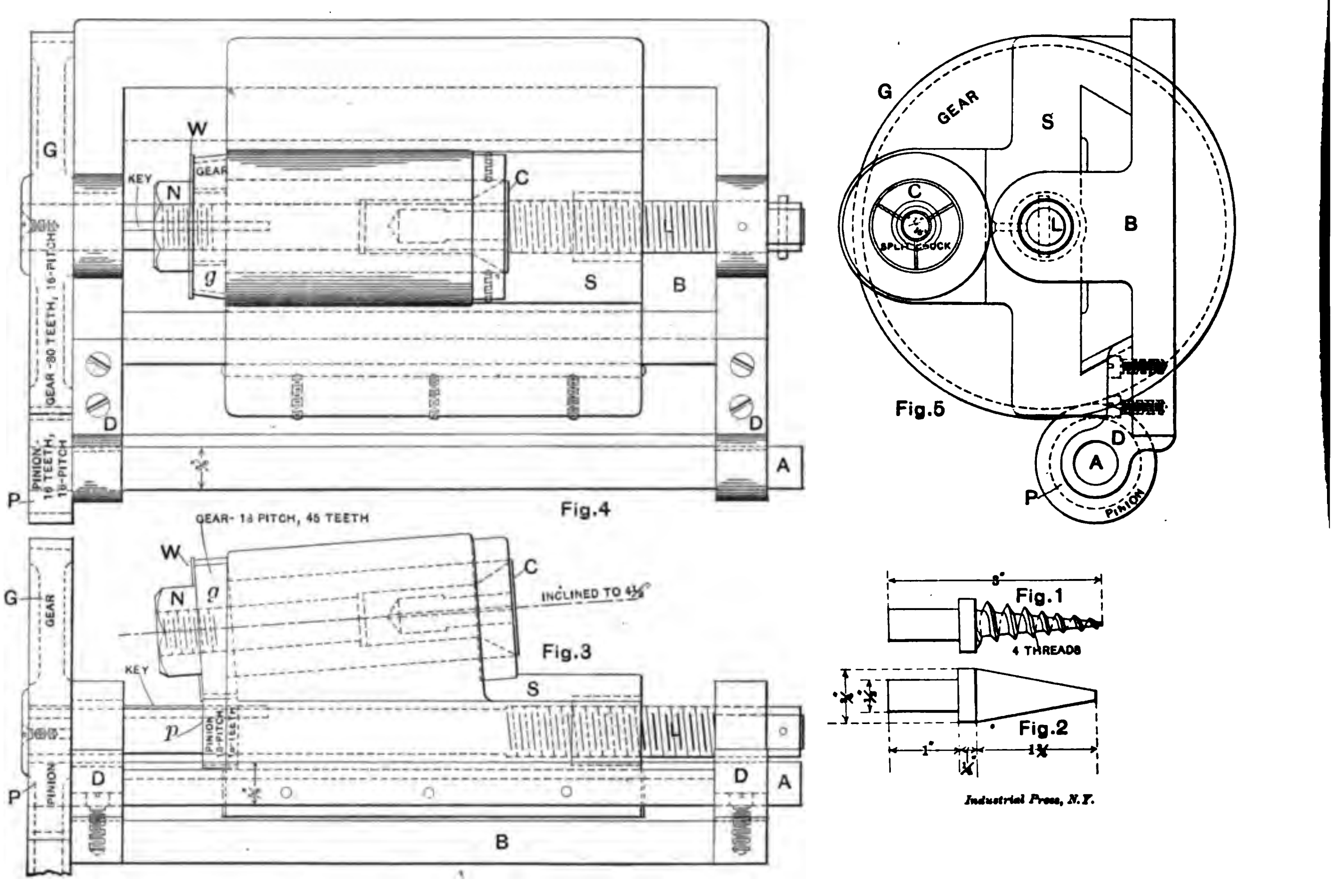


Details of Fixture for Milling Lag Screws.

THE PLATFORM SCALE AS A COMPUTER.

Editor Machinery:

I do not pretend to say that the following is either new or original, but I give it, knowing that many of the readers of Machinery will be placed in the same position at the end of the year that I will, that is, of taking the annual inventory of the stock room and much of the stock will have to be accounted for as so many pieces. Now if you have an ordinary 600-pound platform scale, you will find that the 100-pound weight actually weighs only 1 pound, which thus makes the ratio between the weights on the platform and beam 100 to 1 for a balance. Now if it is desired to count 1,000 pieces of any stock article, which pieces are all of the same weight, place ten of them on the weight-hanger of the scale beam and enough more on the platform to just balance the beam, when it will be found that there are just 1,000 pieces on the platform. This scheme will work equally as well on any scale where the ratio between the beam and the platform is known; as, for instance, if the 100-pound weight of a scale is found to weigh ½ pound, one piece of any stock article on the beam will require 200 pieces of the same weight on the platform for balancing, because the ratio between the beam and platform is 200 to 1.

Detroit, Mich. W. F. T.

Toronto, Ont. It has proved itself a very useful adjunct to the shop for pressing in side-rod bushings, axle-box brasses, etc., so that I think it will be of interest to readers of MACHINERY.

It consists of an air cylinder *A* acting upon the ram *B*, and a dashpot cylinder *C*. The air cylinder is 30 inches long and is bored to 20 inches in diameter. The piston *D* in the air cylinder is cast in one piece with its piston rod or ram *B*, the

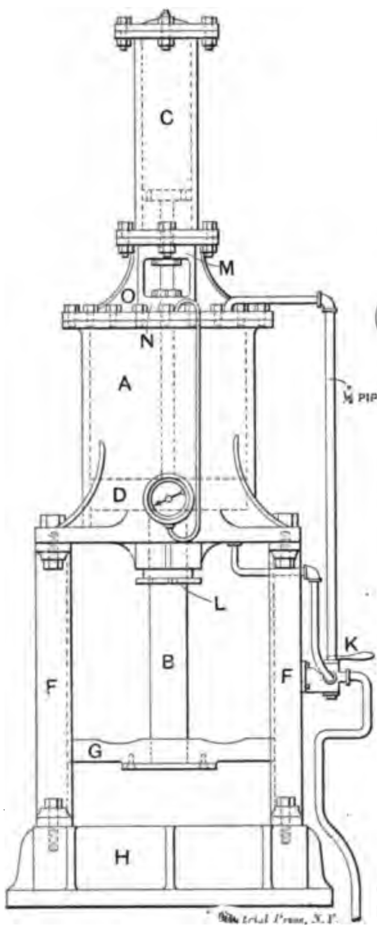


Fig. 1.

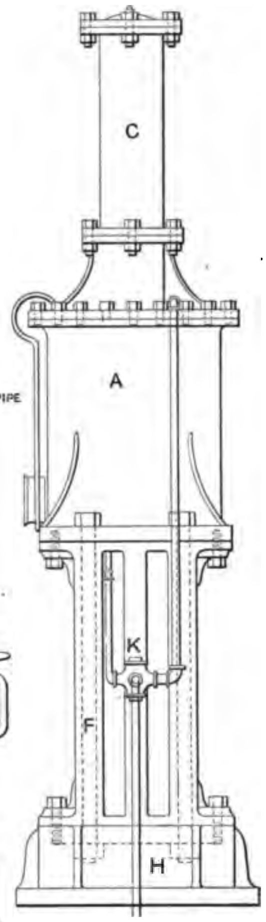


Fig. 2.

latter being bored out. The packing used on this large piston consists of ordinary snap rings. The small cylinder *C* at the top is of the same stroke, but only six inches in diameter, and is permanently filled with oil. Its piston is also of cast iron and is connected to the large piston *D* by a 1½-inch steel piston rod, which passes through the two stuffing boxes *M* and *N*. The small piston has two holes through it, as shown by dotted lines in Fig. 1, through which the oil in the cylinder passes when it is moving up or down, impelled by the large piston in its movement. Thus it acts as a cushion or dashpot to prevent sudden dropping of the heavy ram to the bottom of the cylinder when a bushing or brass has been pressed out of the work.

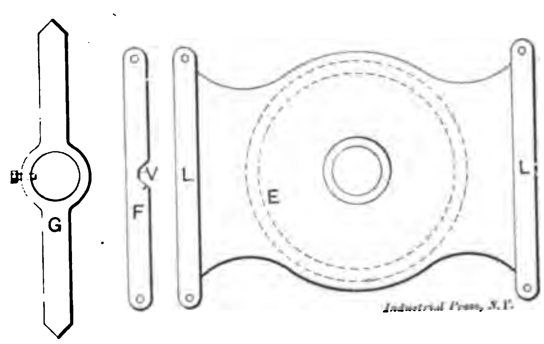


Fig. 3.

E, Fig. 3, is an end view of the lower end of the large cylinder casting *A*, showing the lugs cast on by which to fasten it to the supporting columns *F F*, Figs. 1 and 2. *F*, Fig. 3, is a cross-section view of the supporting columns *F F*, which besides acting as supports serve to guide the cross head *G* on the lower end of the ram. V-ways are planed vertically on the insides of the supports, as shown at *V*, to correspond with the ends of the crosshead *G*. These columns *F F* are bolted down to a heavy cast-iron base *H*, upon which the work rests while being operated upon, and which serves as a base for the press. A combination head *O* is used to connect the dashpot cylinder *C* to the top of the air cylinder *A*, and it is in this casting *O* that the stuffing boxes *M* for the bottom of the cylinder *C*, and *N* for the top of the cylinder *A*, are inserted. The three-way cock *K*, Figs. 1 and 2, is connected up with ½-inch pipe, so arranged that the operator can admit air pressure on either side of the piston to raise or lower it. A pressure gage is connected to the upper end of the air cylinder and located handily at the front of the press. The air pressure usually carried at the shop is 80 pounds.

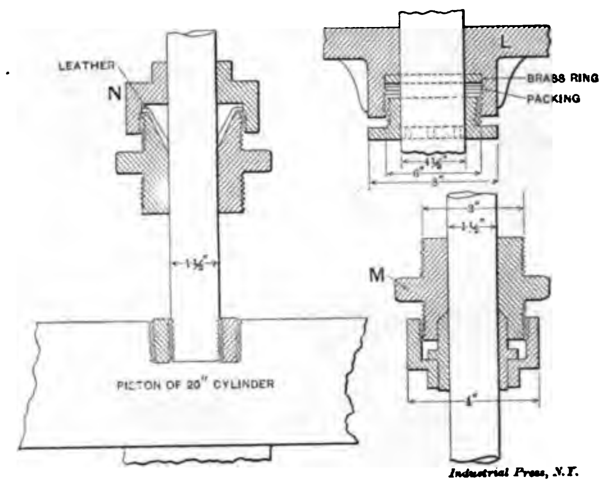


Fig. 4.

In Fig. 4 are shown in section the different forms of stuffing boxes used on the press. *N* is the stuffing box used at the top of the air cylinder *A*, in which a conical leather bucket-ring packing was found to be most satisfactory. *M* is the stuffing box used at the lower end of the oil cylinder, and *L* is the one used at the lower end of the air cylinder on the large ram *B*, which is 4¼ inches in diameter. As may be seen in the sketch, Fig. 4, *L* is packed with a flat ring packing backed up by a brass ring at the top.

With this press work can be much more uniformly fitted than by the usual methods of using a screw or, as is most frequently the case, "main strength and a sledge hammer." Also a very great saving of time is effected by its use. An interesting fact in this connection is that prior to its use much difficulty was experienced in getting a fitter to remain long on a job of fitting axle brasses, for the reason that the work was too laborious; but now no trouble of this kind is met with, the fitters in fact preferring the job of fitting to other jobs. The press will not be found to be expensive to build, especially in consideration of its usefulness.

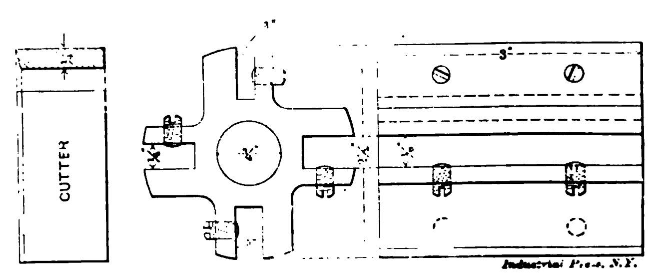
Toronto, Ont. OBSERVER.

* * *

FACING-CUTTER GRINDING FIXTURE.

Editor MACHINERY:

I am sending herewith a sketch of a fixture for grinding facing-cutters, which is a very convenient tool, as by its use one is absolutely sure to get a straight cutter. It is of cast



Grinding Fixture.

iron, and of the shape and dimensions shown in the accompanying sketch. The cutters are placed in the slots and ground the same as a milling cutter. The slots are made

production to 50,000 tons per annum, and place it at a price which might seem prohibitory, but from its quality they can afford to so charge themselves.

The ore, which now comes from entirely underground operations, is magnetite, with an average of 50 per cent of metallic iron, and from 0.0025 to 0.005 per cent phosphorus. It requires very little flux in the blast furnace, as the gangue is principally limestone, and the phosphorus is of that minute quantity which generally leads one to doubt the chemist's reputed results.

The mine has been operated for at least 400 years. At first it was owned by private parties, but later reverted to the government. In 1863 it was again taken by individuals, and has been successfully worked ever since. Up to 1829 the ore was disrupted by fire setting. In that year the use of gunpowder was introduced. As the present working depth is 846 feet, visiting the works seems like penetrating the bowels of the earth, and when we reflect on the great age of the mine and the primitive character of its first exploiting, we could not help feeling that from some dark corner might come the spirit of the ancient Norseman to ask why we were intruding upon its original home.—Robert W. Hunt, in *Cassier's Magazine.*

GAS VS. STEAM.

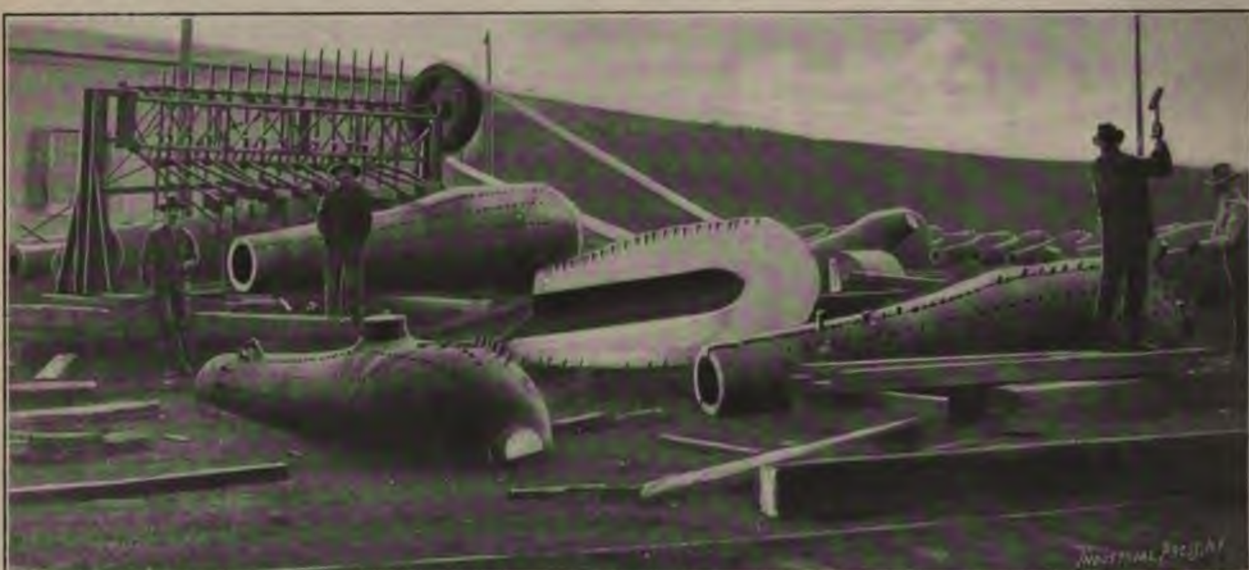
A question not yet settled to the satisfaction of engineers is whether or not the gas engine can be economically substituted for the steam engine in plants of moderate size. That gas engines are now built in sizes of several hundred horse power that run economically and satisfactorily under certain conditions there can be no doubt. But will they prove economical under the varied conditions met by the steam engine in every part of the country? On the question of economy the *Engineering News* has the following to say:

In point of fuel economy, as is well known, a gas engine of moderate size is on a parity with the largest and most completely equipped triple-expansion steam engine. Either will give a H. P. hour for each 1 to 1¼ pound of coal fed into the gas generator or boiler furnace. The remaining items are cost of plant and availability. Now that there are at least two systems (the Mond process and the Loomis process), by which power gas can be successfully made from bituminous coal, or in fact any kind of fuel, the gas engine and steam engine are everywhere equally available. The remaining question of first cost is really the vital one. We are informed that a complete gas-producer plant can be erected for 125 to 140 per cent of the cost of a corresponding complete steam boiler plant. A difference of this magnitude might easily be offset by increased economy in operation. But when we consider the engines the difference is far greater. The gas engine weighs two or three times as much as a steam engine of equal power, and the cost is in nearly the same proportion. Moreover, we are told that it is difficult to secure large gas engines in the market at the present time. The question confronting us, then, is for the gas-engine manufacturer to solve. To the conservative engineer the gas engine is, as it always has been, a very interesting machine with great possibilities, but for general large power purposes its cost is still prohibitory.

BREAKING UP FIFTEEN-INCH CAST-IRON GUNS.

Some months ago a large number of old cannon were sold at the Mare Island Navy Yard. The largest of these guns were 15-inch smooth-bore Dahlgrens of cast iron, made in the early '60's. The problem which confronted the purchasers was how to break them up into pieces of merchantable shape, which in this instance must not be larger than about 200 pounds weight.

After considering several methods and making some experiments, the contractors adopted the method of drilling rows of holes longitudinally, driving steel wedges in these holes till the guns split open, and later breaking the parts into smaller pieces with giant powder. The method of drilling and splitting the wedges is plainly shown in the illustration. The guns were jacked up on roller bearings so they could be easily revolved and a frame carrying 15 drills was set over the gun. The holes were 1 inch in diameter and about 7 inches deep. After drilling one set of holes, the drill was shifted endwise about 4 inches, and a second set of holes was drilled. In this way rows of holes about 4 inches apart were drilled entirely around the gun, the rows being spaced about 8 inches apart on the circumference. The drills were operated by a 30-H.P induction motor with current from the Yards & Docks generator.



Breaking up Cannon by first Drilling and Wedging and then Using Dynamite.

The guns were split open with steel wedges. Two men using 12-pound sledges opened one gun in a day. An effort was made to continue the splitting by wedges, but this was unsuccessful and powder was used to finish. A barricade or bulkhead of 12 by 12-inch timbers was built over the pieces and under this the segments were broken into small fragments with sticks of 40 per cent nitro-glycerine powder inserted in the holes and fired. Each gun weighed 42,000 pounds, and it required two men four weeks to drill it, and then two weeks more to break it up with wedges and powder.

One of the most interesting things in the illustration is the enormous power of the wedges. Near the breach the thickness of metal was 17 inches, and this thickness tapered to the muzzle, where it was 3 inches. A start was made near the muzzle and then as the metal cracked it was followed back until the breach opened as nicely as a hickory log. Some of these guns had never been fired, and these were much more difficult to break up than others.

[The above account was contributed by Frank H. Green to the *Engineering News*, to which publication we are also indebted for the photograph from which the illustration was made.—EDITOR.]

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

The Cincinnati Milling Machine Co., Cincinnati, O., have brought out a vertical spindle milling head for use on heavy knee-type milling machines. The spindle runs in adjustable boxes and its end is threaded on the outside the same as the end of the horizontal spindle of the No. 3 and 4 machines made by this company. It also has the same size taper hole, so that all tools are interchangeable between the horizontal and vertical spindles. The head can be swiveled in a vertical plane through 360 degrees and is graduated.

J. T. Slocomb & Co., Providence, R. I., have recently brought out a micrometer caliper in modified form, designed for measuring the thickness of the walls of tubes, and similar work. It is also useful to tool makers on jig work, in testing distances of holes from the edges of a piece of work. The principal parts of the caliper are like the standard one-inch Slocomb micrometer caliper, but the outer end of the frame which carries the anvil is beveled so as to reduce the width of the frame at this point and allow the anvil to enter the tube or hole. Since the anvil of the Slocomb caliper is practically solid with the frame, the adjustments being made at the other end, it is an easy matter to so shape the anvil as to adapt it for special purposes. In this case the frame is made narrow enough to allow the anvil to enter a hole 7-16 inch in diameter and to a depth of ¾ inch. The anvil itself is spherical on its end, so that it will bear correctly against the cylindrical surface of a hole.

IMPROVED DRILL SOCKET.

A new drill socket is now manufactured by the Cleveland Twist Drill Co., Cleveland, Ohio, the leading feature of which is the shape of the slot in which the drift pin fits. In the usual form of socket the drift pin bears on the corner of the drill tang, and the workman must hold the drift with one hand while he strikes it with the other, and he needs three hands if he wishes to prevent the drill from falling out and striking the drill table or the work. In the new socket the drift will stay in position, whether it is hit hard or lightly, and one hand is free to hold the drill. The drift rests squarely upon the top of the tang of the drill, and it can be driven in from either side of the socket, the double bevel making the drift fit equally well either way.

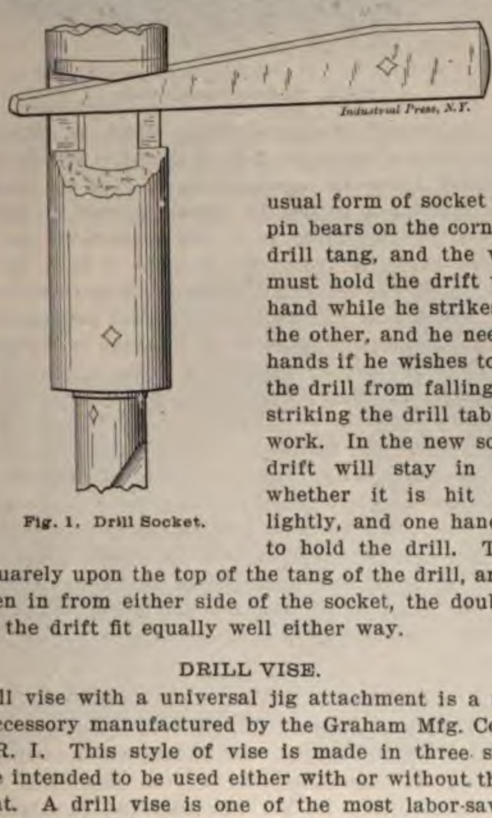


Fig. 1. Drill Socket.

DRILL VISE.

A drill vise with a universal jig attachment is a new and novel accessory manufactured by the Graham Mfg. Co., Providence, R. I. This style of vise is made in three sizes and they are intended to be used either with or without the jig attachment. A drill vise is one of the most labor-saving features that can be applied to a drill press, since it provides means for quickly clamping or releasing work, and as it can be moved about on the drill press table, avoids the necessity for shifting the arm or table of the drill press.

The jaws of the vise are faced with unannealed cast steel. It has been found by experiment that the quickest method for releasing or clamping the work is by a coarse pitch screw, and this is used in preference to some quick movement device for the movable jaw. The jig attachments are intended for duplicate drilling, thereby saving the time and trouble of laying out work and also preventing the drill creeping to either side. The way to use the jig is to lay out and drill one piece, and paint this red or some unusual color; this being understood to be a sign that it is not to be used, but to be kept for a sample or template to set up the jig by when similar pieces can again be drilled without marking off or using the draw chisel.

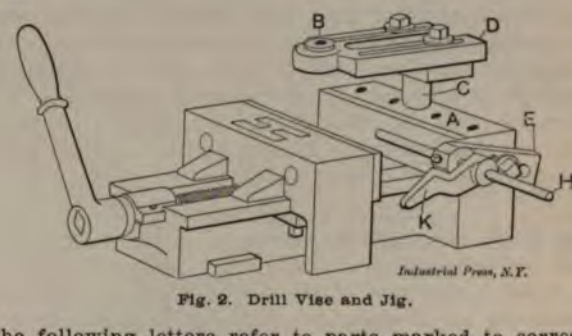


Fig. 2. Drill Vise and Jig.

The following letters refer to parts marked to correspond on the engraving:

B is one of several interchangeable bushings with interior holes of different sizes, but common outside diameter. *D* holds this bushing and may be swivelled to any desired position. It may and will generally be used without holder *C*, that is, firmly secured to vise proper at *A*. *C* is the bushing holder stand. It is movable up and down and can be made to swivel. It is held by a clamping device, not shown in cut. *E* is a movable fixture to hold stops. *H* and *K* are movable pieces and the immediate stop against which the work is brought.

HORIZONTAL MILLING MACHINE.

The Becker-Brainard Milling Machine Co., Hyde Park, Mass., have recently brought out a Lincoln type milling machine. The table is heavy, with feed automatically tripped at any position in the entire length of the longitudinal feed, and has a transverse adjustment of 5 inches, with a quick-return handwheel conveniently located. It has three slots of standard size, and is provided with oil pockets on each side and end. The spindle, of hammered crucible steel, runs in self centering adjustable bronze boxes, is back-geared 6 3-10 to 1, has a No. 10 B. & S. taper, and is mounted on a heavy carrier accurately scraped to the head and firmly held with four bolts, having a

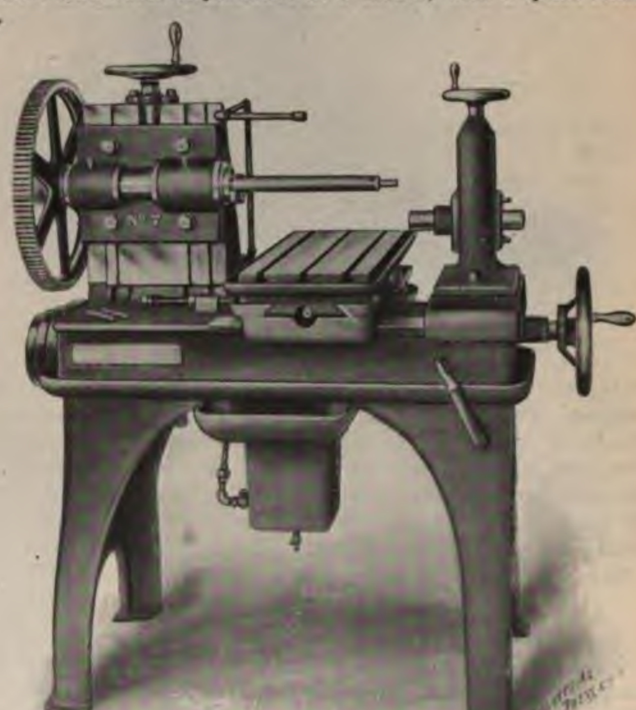


Fig. 3. Becker-Brainard Milling Machine.

bearing 13 x 11 inches on the face. The spindle carrier is supported upon the upright column, is elevated by a single screw with micrometer adjustment, and is also provided with a stop screw to enable the operator to return the spindle to exactly the same position. It is gibbed its whole length to take up any wear, which insures accurate alignment. The design of the bed in the upright column is similar to that on the heaviest types of long feed machines, thus giving absolute rigidity. The steel feed worm is attached to the carriage, runs in oil pockets and is splined to the feed shaft to overcome any side thrust. The tail post is adjustable to take different lengths of arbors and has a hardened steel tail center, also adjustable. The machine is provided with a complete oiling apparatus when desired. The vertical adjustment of the spindle is 8 inches; the diameter of spindle 2½ inches; number of steps on cone, 3; the largest step on cone, 10 inches; the smallest step, 6 inches; number of feeds for each speed, 4; and width of belt, 2½ inches.

BESLY BAND GRINDER.

The Besly Band Grinder, made by C. H. Besly & Co., is a neat and efficient form of polishing machine, and in Fig. 4, is shown a new type of this machine, so designed that an operator can use it when sitting down. It is also built with the usual upright pedestal. The band wheels are made of semi-steel castings and the emery or other abrasive material is applied to the wheel on a cloth band which is slipped on to the wheel. The two ends of the band pass through a slot in the periphery of the wheel, and are drawn tight by a special device on the inside of the rim. To reset the wheel

Fig. 4. Band Grinder.

it is only necessary to remove a band and replace it with another. Felt covered wheels are furnished, if desired, and are to be used when a soft polishing surface is necessary. The band of cloth carrying the abrasive is then fastened on the outside of the felt. One of these machines equipped with an assortment of bands will do the work of an ordinary buffing and polishing frame, and makes it unnecessary to have a large and expensive assortment of wheels.

A NEW RADIAL.

The Bickford Drill and Tool Co., Cincinnati, O., have brought out an entirely new design of radial drill from designs and patents of H. M. Norris, their works manager. Three sizes and four styles of this machine are now being built, the smallest of which is illustrated. The machine has a large number of speeds and feeds. Directly connected with the feed mechanism there is a dial depth gage that enables the operator to read all depths from zero instead of between intermediate points on a fixed scale; the traverse of the spindle is controlled by an absolute safety stop; the tapping device operates at all speeds; and the machine is provided with a multiple automatic trip, which at one setting can be made to trip the feed at as many different depths as there are holes in the work being done, this being one of its most novel features. In place of the usual cone there is a single drive pulley from which power is transmitted through what the manufacturers call the speed box, mounted on the base at the left of the column. This box contains gears and friction clutches, which by means of one lever can be made to give any one of four speeds. As compared with the customary cone pulley drive, the advantages claimed for this speed box are that it does away with all belt shifting, can be driven from below the floor, can be driven by a quarter twist belt if desired, and is well adapted to the application of electric motor drive.

From the speed box the power is transmitted through mitres to a back gear box mounted behind the column on the arm sleeve. This is practically a second speed box, for it

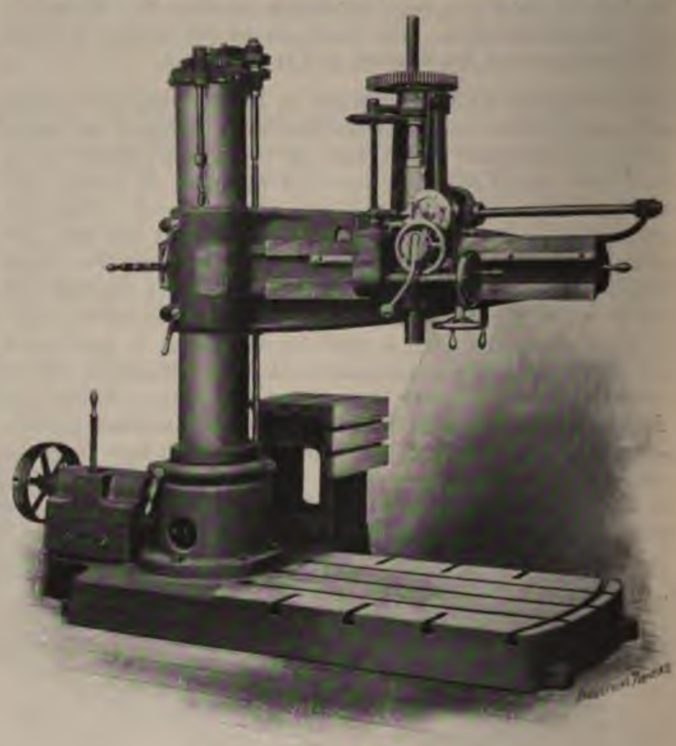


Fig. 5. Bickford Radial Drill.

contains gears and friction clutches, which by means of the two levers shown at the far left of the arm give four speeds, the varieties being so arranged as to give in combination with the speed box proper 16 spindle speeds in geometrical progression, ranging from 16 to 266 revolutions per minute.

The feed range is from .005 inch to .1 inch per revolution of spindle, the operating gears being so related as to divide this range into 8 feeds in geometrical progression. The feed gears are mounted in a box on the head to the left of the drill spindle, and are operated by a lever, a quarter turn of which changes the feed either to the next higher or the next lower.

It will be seen that the speed, back gear and feed box levers give the operator instant and easy control over the cutting tool, one speed and feed being just as easy to get as any other, so that in this machine there would seem to be no sense whatever for not running every drill at its proper speed and feed, especially as engraved index plates, fixed to the machine, indicate the positions of the several levers and the proper speeds and feeds for all diameters covered by the range of the machine.

FIFTY-TWO INCH BORING MILL.

One of the new machines exhibited at Buffalo by the Prentiss Tool and Supply Co. was the 52-inch screw-cutting, boring and turning mill manufactured by the Rogers & Hemphill Machine Co., Alfred, N. Y. The machine is illustrated in Fig. 6 and has a number of new features. The housings are of the box type and extend clear to the floor. The cross-rail is raised or lowered by power and carries two heads, and all the bearing surfaces upon the rail and in the saddles and heads are unusually large. Accurate graduations are provided for the heads.

The table has 16 T-slots and can be stopped at any desired position by means of the brake in connection with the foot lever shown at the side of the base. The table gear and pinion are accurately planed and the teeth are protected from chips. Each head is entirely independent of the other in respect to its feeds, etc.

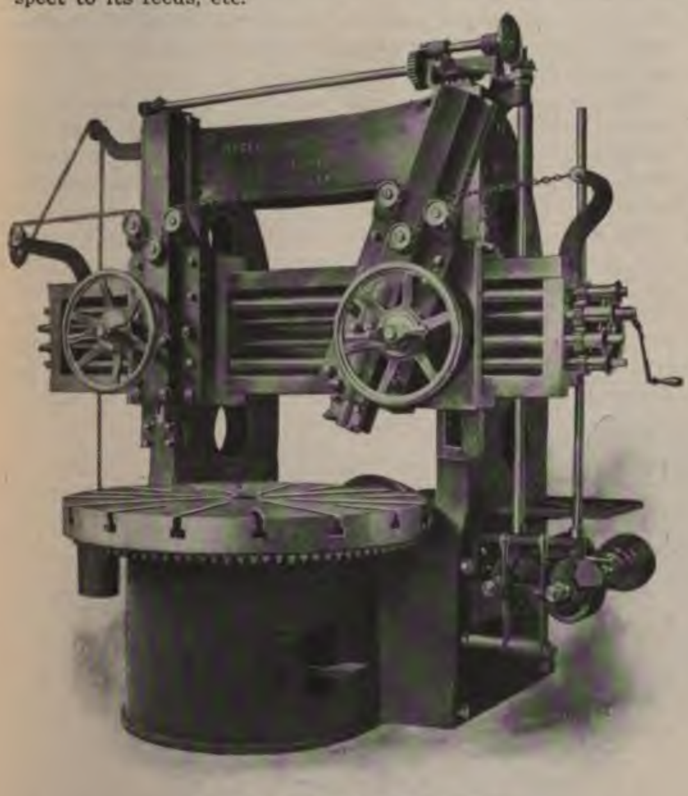


Fig. 6. Fifty-two Inch Boring Mill.

The feeds are positive and are operated by cones of gears. They are designed with special reference to thread cutting, and all standard threads can be cut from 2 to 12 per inch, including 11½. This is a great convenience in the case of large flanges and similar work which has to be threaded, since they can be finished complete on the mill and need not be removed to a lathe for threading.

THREE-WAY FACING MACHINE.

The Beaman & Smith Company, Providence R. I., beside manufacturing a number of standard machines, particularly milling and boring machines, design and build a great many special tools. One of the recent machines of this character

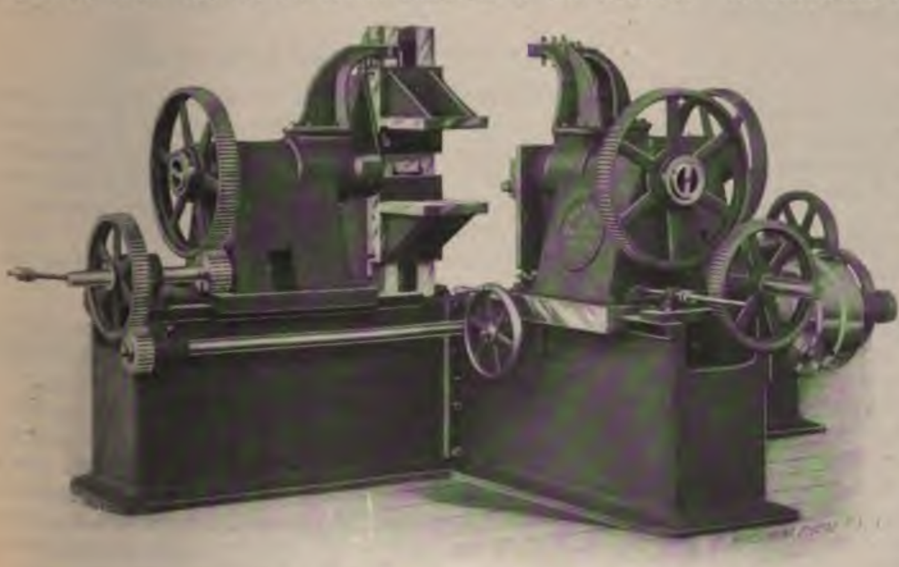


Fig. 7. Three-way Facing Machine.

is a three-way facing machine shown in Fig. 7, adapted for facing simultaneously three sides of a casting such as pipe fittings, or any work requiring three sides to be machined, with the adjacent sides at right angles with one another. There are three heads mounted on suitable beds, each of which is provided with independent adjustment and carries a spindle of large diameter running in hard bronze boxes. The spindles are driven in unison by a 4-inch belt on a four-section cone, through gearing, in the ratios of 11½ and 38½ to 1. At the front end of each spindle is attached a facing head provided with a saddle-carrying tool and with automatic feed in either direction by means of a star wheel and kicker pins, and capable of facing to 24 inches diameter. The least distance between the two heads is 10 inches and the greatest, 40 inches; while the other head is placed at a right angle to the others with equal adjustment from a common center. The work is held in suitable fixtures fitted to a two-jawed chuck or vise, forming a part of the machine. The chuck is mounted on a carriage supported by a bed and has a horizontal movement, by means of rack and pinion, for the purpose of conveniently placing and removing the work.

NEW DOWN-DRAFT FORGE.

In the accompanying cut, Fig. 8, is shown a new type of down-draft forge adapted for heavy work, such as is met with in railroad repair shops and other situations of a like

Fig. 8. New Buffalo Forge.

nature. As will be perceived, the forge is constructed of steel plate of a heavy gage with cast iron exhaust hood and connections. Blast gates are attached to the forge with levers for controlling the blast, and the Buffalo anti-clinker dumping tuyere permits ready cleaning of the fire without undue disturbance of the same. As will be noted, a convenient water tank is provided, as well as a novel coal hopper in the body of the forge itself. The hood is adjustable to various positions at the fire, so that smoke and gases may be efficiently exhausted under all conditions. The forge is manufactured by the Buffalo Forge Co., Buffalo, N. Y., who have made a specialty of down-draft forges, doing away with overhead piping, and the heat and smoke so prevalent in many forge shops.

TWIST DRILL GRINDER.

The Standard Tool Co., Cleveland, Ohio, have brought out a twist drill grinder, shown in Fig. 9, which is adapted for drills from ⅛ to 2¼ inches in diameter. It will grind right or left-hand drills, flat drills, two, three or four-lipped drills or three-groove chucking reamers. A geared pump with supply tank is fitted to the machine, giving a continuous feed of water on the wheel. When the machine leaves the factory it is set to grind at an angle of 59 degrees, but it can be adjusted to grind a wide range of angles, both above and below 59 degrees. The various adjustments for drills of different sizes and angles are easily and quickly made, and are as follows:

First, place the drill in *V* drill holder, and screw up drill stop *A* until the tip of the drill extends about 1-32 inch ahead of drill guide *B*. Second, loosen the clamp on the right side, and move handwheel *C*, on the left side with the brass dial up to a point indicating the size of the drill; then tighten the clamp on the right side. Third, turn the handwheel *D* under the machine until drill guide *B* comes to within 1-32 inch of the face of the emery wheel; then tighten side handwheel *H* to hold rigid. Turn the knurled screw head *G* for grinding

Fig. 9. Standard Twist Drill Grinder.

off stock on the tip of the drill. For more or less clearance, loosen setscrew *F* underneath the *V* drill holder, and move either right or left until the proper clearance is obtained; then tighten the setscrew. For more or less angle, loosen the two screws *S* on the taper bearing, and move the *V* drill holder up or down until the angle required is obtained; then tighten the T-slot screws. Corresponding marks on the taper bearing indicate the proper position of the machine for grinding an angle of 59 degrees.

PLAIN MILLING MACHINE.

A plain milling machine, new in design and known as No. 24, has recently been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. Several important features that have not been combined before in a machine of this size and capacity are embodied in its construction.

The machine is built for work requiring unusually large table capacity and long cuts. Exceptionally heavy gearing is provided, thus fitting the machine especially for the requirements of machine tool builders, engine and railroad shops, and the heavier class of milling in general.

The following details relative to its construction may interest our readers: The steel spindle has ground and lapped bearings and runs in phosphor bronze boxes, provided with means of compensation for wear, and is driven by a worm wheel, the worm wheel being made of phosphor bronze, while the worm is made of steel, hardened, and runs in oil. The thrust of the worm is taken by ball bearings. Provision is made for taking up the wear of the worm and wheel, thus insuring proper contact and the smooth running of the spindle.

The spindle cone runs idle and in the same direction as the shaft on which it is mounted, thus reducing the friction to a minimum. It has only two steps; the power being transmitted through a system of gearing, arranged to give an exceptionally high ratio.

The changes of spindle speed are obtained by means of transposing gears. With two speeds of the countershaft, 8 changes of speeds are obtained, varying from 15 to 100 revolutions per minute. The advantages of this method of driving are readily appreciated, as the speed of the spindle cone is maintained more uniformly than when the changes of speed are wholly dependent upon the number of steps in the cone, and the power is not reduced to as great an extent when slow speeds are required for heavy cuts.

The method of clamping the spindle head and knee is improved, each being clamped by one lever in place of two, as formerly. This will tend to show the care and attention given throughout to the details of convenience in the manipulation of the machine.

The arm support is exceptionally rigid and of improved design. It is made in two parts, clamped directly to the front of the knee, and can be easily placed in position or removed. The two parts slide upon each other, and are clamped in position by bolts passing through the slots. This form admits of a bearing for the outer end of the arbor directly in the support, and allows the adjustable arbor support to be used at any intermediate point in the arbor.

Fig. 10. New Brown & Sharpe Milling Machine.

The table is supported directly in the knee, which is very long for the capacity of the machine. Another important feature to be noted is that the table remains locked in position when the feed is automatically thrown out. Adjustable dials, graduated to read to thousandths of an inch, indicate the longitudinal, transverse and vertical movements of the table. A dial, graduated to read to 64ths of an inch, indicates the transverse movement of the head.

AXLE TURNING LATHE.

One of the new machines that is being manufactured by the Grant Tool Co., at their new plant, at Franklin, Pa., is a 10-inch car axle lathe, shown in Fig. 11. It is an unusually powerful and massive machine, even for the class of work for which it is designed, and it swings 8 feet 2 inches between centers and 10 inches over the carriages. The carriages are guided on the bed by a V-track on the front, having a surface of over 4 inches, and at the rear by a flat surface of about the same area. They are fitted with tandem tool posts and are self oiling. The right-hand tail-block spindle is moved by a worm and worm wheel gearing, and it can be operated on either side of the lathe. The clamping device is positive, preventing the tail block from sliding back from the work. The cross feed screws of the carriage are geared three to one, making it easy to adjust the tools when necking into the

k or in cutting off stock.

ide from the massiveness and great power of the machine, chief features are the method of driving the work and arrangement for placing the work in the machine, or for oving it. As usual in such lathes, the driving head is at center and consists of a gear with a large hub running in ible bearings. There is a large hole through the center e gear, through which the work passes, the driving being neans of suitable dogs or clamps. The general arrange- t of the driving head is shown in Fig. 12, where G is the ing gear, having the hubs a and b, which support the gear s bearings. A segment is cut out from this gear, as shown and when the gear is in such a position that this opening s opposite a corresponding opening in the gear casing.

Fig. 11. Grant Axle and Forging Turning Lathe.

xle can be rolled into place between the centers or can olled out of the lathe when finished, without having to it through the gear, end first, in the usual way. Since ng out this segment makes a break in the continuity of eeth of the gear, a special driving arrangement is pro- l. The driving shaft is at T, and the pinion D at its end s two idler gears I I, both of which mesh with the main These idlers are separated enough so that when one is out of contact with the driving gear, owing to the on where the segment is cut out, the other idler will do riving. In the sketch the right-hand idler is just passing f contact at point x, and the other one has passed into

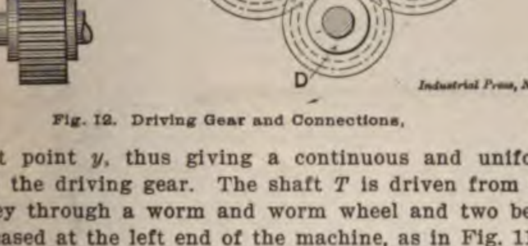


Fig. 12. Driving Gear and Connections.

ct at point y, thus giving a continuous and uniform n to the driving gear. The shaft T is driven from the pulley through a worm and worm wheel and two bevel , encased at the left end of the machine, as in Fig. 11.

arrangement operating the feed-rod is very simple, g less than one-half the number of pieces generally used e lathes, is positive in action, and quickly adjustable for ariation of feed from 1-16 to 3-16 per revolution of axle.

* * *

first electric railroad in Russia has been opened this It is 13½ miles long, and connects the manufacturing f Lodz, in Russian Poland, with neighboring towns.

FRESH FROM THE PRESS.

ELECTRIC IGNITION FOR GAS, GASOLINE AND OIL ENGINES. By Harry B. Maxwell. Published by the Maxwell Engineering Co., Rome, N. Y. Price, $1.00.

There are two principal methods of electric ignition, namely the primary or hammer-break spark and the secondary or jump spark method. In this pamphlet there are working drawings for successful devices for both methods, and which are stated to infringe no patents and are free to be used by all. There are four pages of text explaining the drawings and ten plates giving full details.

LINEAR DRAWINGS AND LETTERING FOR BEGINNERS. By J. C. L. Fish, Assoc. Prof. Civil Engineering in the Leland Stanford, Jr., University. Published by the author at Palo Alto, Cal. Price, $1.00.

This book is intended to furnish the student enough training in the use of drafting implements to enable him to construct accurate pencil drawings, make clean-cut ink lines and do legible lettering. It embraces the instruction given by the author as preparation for drafting in courses in descriptive geometry, machine drawing and surveying. There are four folding plates and the instruction as to the use of the instruments, irregular curves, triangles, etc., is given in great detail, both in the text and by suitable illustrations. The subject of lettering is also treated very fully, not only taking up the form and proportion, but also pointing out the difficulties met with by a beginner. Accompanying the text-book is a blank book containing 32 pages suitably ruled for practice in lettering. The price of this is 25 cents.

HOW TO BUILD A THREE HORSE POWER LAUNCH ENGINE. By E. W. Roberts. Folio size, with numerous plates. Published by the Gas Engine Publishing Co., Goodall Bldg., Cincinnati, O. Price, $2.50.

The object of this book is to furnish a design for a complete gasoline launch engine, together with the necessary instructions for its construction. In proportioning the various parts the rules given in the author's "The Gas Engine Handbook" have been followed, and in order that the formula may be looked up in any particular instance, references to the handbook are given in the text. In preparing this work the author has first made a complete set of shop drawings, nearly all of them full size, and then reduced the drawings to make the plates in the book. Details are given for all the parts, with full dimensions, and assembled drawings are shown where necessary. The engine has been designed so that it may be built with the tools found in the average machine shop, no piece except the flywheel—which is 18 inches in diameter—requiring a lathe larger than 16-inch swing. This is a four-cycle engine, because it is the author's experience that machinists who have had no experience with two-cycle engines are not successful with them. The book is attractively gotten up and the drawings are clear. Blueprints from the original tracings can be furnished, if desired, at an additional cost of $4, when purchased with the book, or $4.50 when bought separately.

COMPRESSED AIR, ITS USES AND APPLICATION. By Gardner D. Hiscox, M.E. Published by Norman W. Henley & Co., 132 Nassau Street, New York. 822 8vo pages, with 545 illustrations. Price, $5.00.

Mr. Hiscox is the author of the well-known books, "Mechanical Movements," "Gas, Gasoline and Oil Engines," "Horseless Vehicles," etc. This, however, is much the most important work that he has produced and is the most complete and comprehensive treatment of the subject of compressed air and its applications that has been published. In fact, we know of no other book which does more than treat the subject in a fragmentary manner. The literature on the commercial uses of compressed air, especially in its application to the mechanic arts, has consisted almost entirely of trade circulars and occasional articles and papers published at different times. There has also been much matter published on the theoretical side of the subject in books upon thermodynamics and in papers presented before engineering societies. This scattered information, however, does not meet the requirements of the engineer, who needs to have his information gathered together in convenient form for reference. As contributor of the *Scientific American*, Mr. Hiscox has had the chance to gather a large amount of information upon compressed air and its applications and this has been preserved and utilized in the preparation of this book.

The scope of the work may be judged by the following statement taken from the title page: The book contains matter upon the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils; the air blast for cleaning and painting; the sand blast and its work; and the numerous appliances in which compressed air is a most convenient and economical transmitter of power; for railway work, railway propulsion, refrigeration and the various uses to which compressed air has been applied. A great many of the illustrations were made especially for this work, while others which illustrate compressed air machinery and devices are taken from trade literature, the effort being made to select such ones as represent the best modern practice in all departments. The book is printed on coated paper and its appearance is exceptionally good. There are in all 36 chapters, with a list of patents upon compressed air devices. The theory of the subject is treated fully and such allied subjects as air applied to pyrometry,

liquid air, pneumatic tube transmission air compressors at high altitudes, the power of the wind, etc., are touched upon. A great deal of attention is given to air compression and to pneumatic tools. Air pressures both below and above atmospheric pressure are considered. There are forty tables for convenient reference and the book impresses us as a very valuable treatise in which sufficient attention is accorded both theory and practice to make a well-balanced book.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

J. M. King & Co., Waterford, N. Y. Price list of tools such as taps, dies, pliers, diestocks, etc.

The Watson-Stillman Co., New York City. Catalogue No. 61, of hydraulic jacks, of which this company make an extensive line. These are made in a great variety for all uses to which such machinery is applicable.

The Standard Pneumatic Tool Co., Chicago, Ill. Illustrated circular of the "Little Giant" pneumatic hammers in which are descriptions of the different sizes of hammers, and illustrations showing them in actual use on different kinds of work.

The Hoggson & Pettis Mfg. Co., New Haven, Conn. Catalogue of the Sweetland chuck and also of tool holders, surface gages and other machinists' tools, steel stamps for both letters and figures, tool room and time checks, etc.

The Peck Drop Press Works, New Haven, Conn. A circular containing useful information and a table enabling one to calculate the relative effects produced by drop hammers falling from different heights. The table is a useful one in estimating the capacities of hammers and will be sent to any address upon application.

The American Tool Works Co., Cincinnati, O. Fifth edition of their catalogue of machine tools. In this catalogue are listed the extensive line of tools made by this company, and as the catalogue is pocket size and contains numerous useful tables, it is convenient for reference. An attractive circular has also been issued upon their Pan-American exhibit.

The Cleveland Pneumatic Tool Co., Cleveland, O. Catalogue of pneumatic hammers, drills and other pneumatic appliances. The tools and appliances made by this company are illustrated, and there are numerous reproductions from photographs showing the actual operation of these tools in the machine shop and on structural work.

The Grant Tool Co., Franklin, Pa. Catalogue of machine tools. This is the first catalogue issued by this company since the establishment of their new works at Franklin, Pa. It is handsomely gotten up and the tools listed include several sizes of hand lathes, a taper-turning lathe, a 16-inch engine lathe, several sizes of turret lathes, upright drills, boring machines, milling machines, worm-wheel hobbing machines and an axle lathe of novel construction.

The B. F. Sturtevant Co., Boston, Mass. Catalogue of the Sturtevant steam hot blast, heating and drying apparatus and dry kilns. The Sturtevant system of heating by a hot blast has been applied so extensively in the machine shops of the country that it requires no description. In addition to treating of this subject the catalogue contains much valuable information and gives many practical hints upon dry kilns and the process of drying, while incidentally the kilns and apparatus supplied by the Sturtevant Co. are described.

The Long & Allstatter Co., Hamilton, O. Catalogue No. 20, of power punching and shearing machinery. This catalogue contains 160 pages, on nearly every one of which is an illustration and a description of the punching and shearing machinery of the various sizes and styles made by this company. This statement gives a good idea of the extensive line of machines which they manufacture, some of which are for the very largest and heaviest work, such as is met with in heavy boiler work and in structural work.

The Chicago Pneumatic Tool Co., Chicago, Ill. Catalogue No. 15 of pneumatic tools and appliances. This catalogue contains an unusually large number of illustrations from recent photographs showing the tools of this company at work on some of the most noted buildings and on other structural work. Among the noted structures are the new East River Bridge, the glass furnaces at Denver, Colo., the Boston Elevated Railroad, battleships of the navy, the State Capitol of Minnesota, etc. In point of variety, showing the many uses to which compressed air can be applied, these illustrations form the most comprehensive group we have seen, and the catalogue is exceptionally attractive in appearance.

The Massachusetts Tool Co., Greenfield, Mass., inform us that they have purchased the entire mechanical tool business of Coffin & Leighton, Syracuse, N. Y., including their machinery, stock, fixtures, patents and good will. They will shortly install the same in their factory and be in a position to supply the wants of their friends. All orders for articles of Coffin & Leighton make should be sent to the Massachusetts Tool Co. to avoid delay. They will soon issue a complete catalogue wherein will be shown tempered steel rules, protractors, surface gages, micrometers and various other instruments of precision of a like or similar character.

The Norton Emery Wheel Co., Worcester, Mass. Illustrated catalogue of emery and corundum goods and grinding machinery. The emery and corundum wheels, emery bricks, etc., made by this company comprise an extensive line adapted to every use to which abrasive materials are now applied. This is a large catalogue containing in addition to a description of their products much useful information. A complete line of polishing and grinding machines is shown, and attention is given to the Walker universal tool and cutter grinder which they manufacture, and the large plain grinding machine made by the Norton Grinding Co. There is also listed the Bath test indicator and a grinding attachment for engine lathes.

Manning, Maxwell & Moore, New York. Illustrated catalogue of railway, steamship, factory and machine shop supplies and tools. This is the largest catalogue issued in the trade, having over 1,000 large pages. The line of machinery, tools and supplies carried by this company is so extensive that two principal catalogues are published, one of which is for metal and wood-working machinery and the other, which is under review, illustrates their line of railway, steamship, machinists' and contractors' tools and supplies. In the matter of small tools, shop, mill and factory supplies, from the motive power to the smallest accessories, this catalogue will be found a convenient guide. There is also an extensive list of electrical apparatus. The catalogue is so extensive that it is impossible to refer to it in a notice of this description except in a general way. It is so well-known in the trade that it is unnecessary to do more than say that this year's issue is even more complete than the preceding ones.

MANUFACTURERS' NOTES.

J. T. Slocomb & Co., Providence, R. I., announce that they have adopted the nine-hour day with ten hours pay.

The Bowen Mfg. Co., Auburn, N. Y., have recently installed in their works two car loads of machinery, a large proportion of it automatic.

The Armstrong Bros. Tool Co., Chicago, Ill., have lately received an order from the Mexican Central Railway Co., Ltd., for over 200 Armstrong tool holders, mostly of heavy sizes, and for a large quantity of steel for use in same, the order amounting to over $1,000.

The Roller Bearing & Equipment Co., Keene, N. H., a[illegible] that they have just had eleven grinding machines added t[illegible] equipment, with several more on the way, to enable them to giv[illegible] many friends quicker deliveries and avoid night work in the [illegible]tory.

The Standard Pneumatic Tool Co., Chicago, Ill., have r[illegible] their general offices from Chicago to their new works at Auror[illegible] where all correspondence should be addressed. They have also [illegible] increased their facilities for manufacturing, which will enabl[illegible] to fill orders promptly.

The Niles Tool Works Co., Boston, Mass., announce th[illegible] Boston office of that company, of Bement, Miles & Co., and [illegible] Pond Machine Tool Co., has been removed to 144 Pearl Street, Mr. Chas. H. Kingsbury, the local manager of the above com[illegible] will be pleased to meet all consumers of the product of the tool manufacturers.

The Cleveland Twist Drill Co., Cleveland, O., announ[illegible] opening of a store at 17 South Canal Street, Chicago, where [illegible] carried a full and complete stock of all the goods of their [illegible]facture for the convenience of the trade of Chicago and vicinity. stock will be in charge of Mr. John G. Ladrick, who has repr[illegible] them in the West for a number of years.

The Cincinnati Milling Machine Co., Cincinnati, O., m[illegible] export shipment of milling machines on October 26th to the fol[illegible] foreign points: Manchester, Liverpool and London, England; B[illegible] Berlin, Vienna, St. Petersburg, Paris and Japan. This woul[illegible] to indicate that the foreign demand in some lines of machine t[illegible] considerably alive.

An interesting round house is that of the Lake Shore r[illegible] Collinwood, O. This house, having a turntable 72 feet in di[illegible] is one of the largest ever built. It is heated throughout [illegible] Sturtevant system, the hot air being discharged to the loco[illegible] pits and serving as it rises to rapidly melt the snow and ic[illegible] the running gear. This method is coming into general use [illegible] new buildings of this character.

The entire interests of the Acme Machine Screw Co., H[illegible] Conn., have been sold to the National-Acme Mfg. Co., Clevel[illegible] Until further notice orders will be accepted and executed as [illegible]fore by the Hartford factory. A new factory is being built in [illegible]land which will be ready for occupancy early in 1902. The N[illegible] Acme Mfg. Co. will manufacture the Acme multiple spindle machine and a full line of cap screws, setscrews and special work turned from steel, iron, zinc or brass.

The American Die & Tool Co., Reading, Pa., reported early in November that on the 8th of that month they had lost their hardening and tempering department. They added the[illegible] expected to be somewhat inconvenienced while they were reb[illegible] but that their many customers would not be compelled to wait than about a week or ten days from the date of the fire. N[illegible] by this time they are in running order once more.

E. G. Smith, Columbia, Pa., writes us that owing to the improved machinery, i.e., automatic screw machines for the [illegible]facture of his "Which Way" pocket levels, he is now able to [illegible] them at a much lower figure, and that he has reduced the [illegible] them to 50 cents apiece net. This pocket level tells in an[illegible] which way the work is out. It is nicely nickeled and polished. specialties are beam callipers in any graduation, vernier or system; micrometers, spherometers, germ-proof filters and fi[illegible] for all trade and scientific purposes.

The Wilmarth & Morman Co., Grand Rapids, Mich., report number of shipments of grinders, among which are: Three t[illegible] bay, one to Rangoon, one to Singapore, two to Hong Kong, Calcutta, three to Shanghai, one to Manila, one to Montreal, [illegible] to the University of Wisconsin, Madison. In addition t[illegible] "style N" wet drill grinders, with self-contained motor, recently to the United States Government, they have orders for the Allis-Chalmers Co., one for the Washington Navy Ya[illegible] one for the Niles-Bement Pond Tool Co.

The Colburn Machine Tool Co. have chosen a fine fact[illegible] at Franklin, Pa., fronting on the Lake Shore tracks, a dist[illegible] 540 feet, where they intend to erect a new plant. Their main [illegible] shop will be 100 by 200 feet, one story high, the front portio[illegible] ever, rising to a height of three stories, and which will cont[illegible] offices and drafting room. They will also have an engine [illegible] 30x45 feet; a boiler room, 27x45 feet; a blacksmith shop, [illegible] feet; a toilet room and lavatory, 25x50 feet, all buildings [illegible] brick and steel construction.

Several important changes have recently been made in the [illegible]ment of the Mossberg & Granville Mfg. Co., Providence. [illegible] recent election Messrs. W. W. Orr, V. I. Cumnock, E. C. Moen[illegible] Whitney, Jr., and Joseph W. Harriman, all of New York, and H. Howard, of Providence, were made directors. The Board o[illegible] tors organized by electing Howard C. Smith, of New York, Pr[illegible] Elisha H. Howard, Vice-President, and E. C. Moen, Secreta[illegible] Treasurer. V. I. Cumnock was made Chairman of the E[illegible] Committee. George A. Clark, formerly of Lowell, Mass., h[illegible] appointed General Manager to replace Mr. W. W. Gibbs, who r[illegible]

The Hyatt Roller Bearing Co., Harrison, N. J., inform [illegible] they received a contract for some 500 roller bearing hangers [illegible] new mill of the Atlas Tack Co., Fairhaven, Mass., which contr[illegible] awarded through Lockwood, Greene & Co., Boston. They a[illegible] making a number of heavy jack shaft bearings for the Wa[illegible] Crosby Co., Minneapolis, and are installing a new jack shaft containing a new electric drive that includes a number of bearings of the Hyatt type, for the American Cigar Co., Jerse[illegible] The mill of the Champion Coated Paper Co., Hamilton, O., [illegible] equipped throughout with Hyatt roller bearings.

Schischkar & Co., of Birmingham, England, have purchased the Acme Machine Screw Co., of Hartford, Conn., their patents a[illegible] automatic screw machines which were granted for the United [illegible]dom of Great Britain and Ireland. These patents Messrs. Sch[illegible] & Co. have disposed of to P. F. Pease & Co., of Darlingto[illegible] don and Worcester, England, whose intention it is to manu[illegible] all sizes of these machines for the English market. Messrs. Sch[illegible] & Co., who are the sole European agents for the Acme Machine Co., have sold fifty of these machines in Great Britain [illegible] months.

The New Process Raw Hide Co., Syracuse, N. Y., throug[illegible] English agents, Messrs. Geo. Angus & Co., have received d[illegible] month of October trial orders for their "New Process" noiseless [illegible] from eleven of the leading electric railway companies in Great [illegible] These trial orders will doubtless lead to a considerable trade near future. The company report their trade in the general ma[illegible] line as steadily increasing, especially in the case of motor machine tools where noiselessness is very essential. Since t[illegible] nouncement a couple of months ago that they are in position to [illegible] accurately-cut metal gears also, the number of orders recei[illegible] work in this line has been very gratifying, and points favorabl[illegible] extended trade.

The American Foundry & Machine Co. have taken a p[illegible] Glenville, Pa., a machine shop and foundry, which is now in [illegible] shape and employing fifty hands. The plant will be run as an [illegible] to their new plant in Hanover, Pa., which they will have re[illegible] occupancy April 1st, and they expect to employ a considerab[illegible] ber of machinists, as well as foundrymen. Their foundry wi[illegible]

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MACHINERY

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MACHINERY.

Vol. 8. January, 1902. No. 5

ELECTRICALLY DRIVEN MACHINE TOOLS.—1.

DISCUSSION OF GENERAL PRINCIPLES, WITH ILLUSTRATIONS SHOWING APPLICATION OF MOTORS.

A. L. De Leeuw.

The electric drive for machine tools has come to stay. It is, however, still in a very unsettled condition. The number of things which are not known about this subject would fill a book. A motor in itself is quite a complex thing, so is a machine tool, generally speaking; and, of course, a combination of the two is more complex than either. It is my intention to point out some of the difficulties one meets when trying to apply a motor to a machine tool, and also some ways in which at least part of these difficulties may be overcome. In order to clearly understand these difficulties we must look at the requirements of machine tools, and at the limitations of the present-day motor.

No one would expect a steam engine to run at any speed, regardless of the speed for which the governor is set. No one would expect it to develop 100 horse power when it is designed for only 50 horse power; and no one would require it to run economically with 90 per cent cut-off if it is built for 30 per cent cut-off. This is quite natural, because we are fairly familiar with the steam engine. It is an old friend, whose value we appreciate and whom we do not despise for its shortcomings. But the motor is a newcomer; its advent has been announced in terms of the highest praise, and we naturally expect a great deal from it. In fact, we generally expect too much—more than we ever would expect of any other kind of prime mover. It is, therefore, perfectly natural that we should be disappointed once in a while.

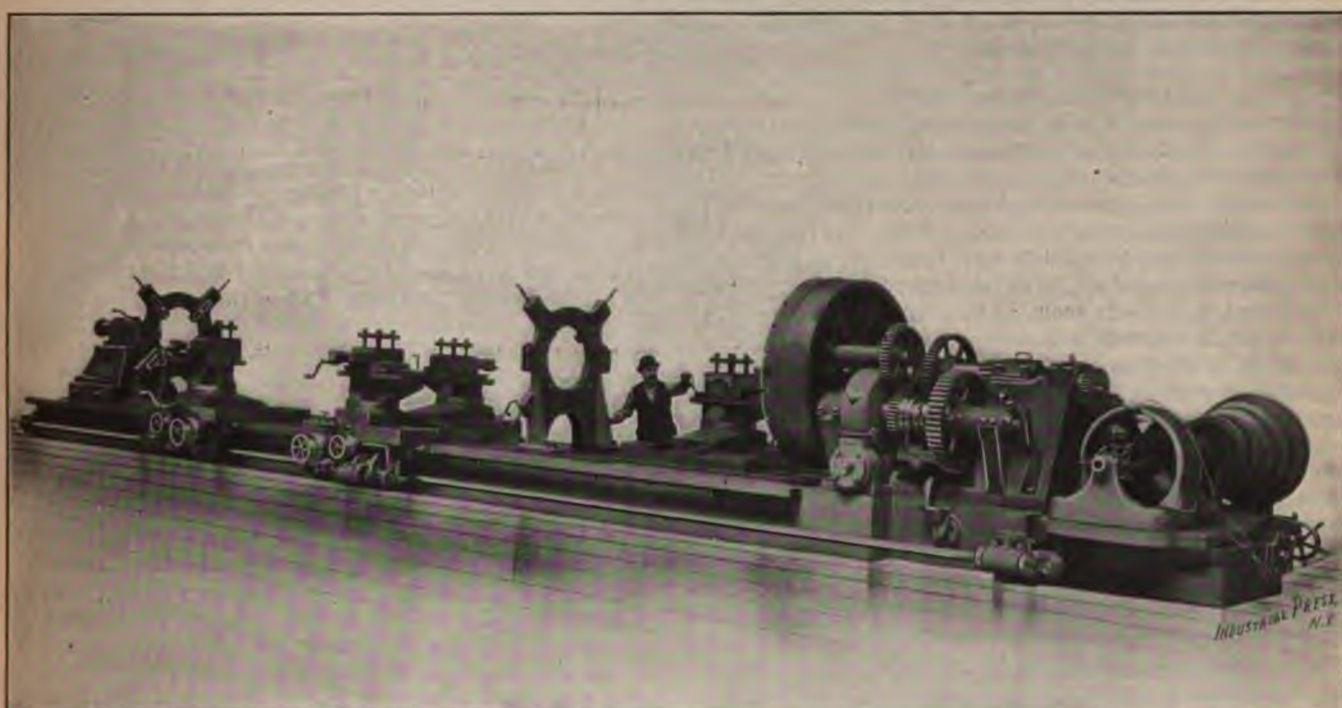


Fig. 1. Sixty-three Inch Niles Lathe with Four Carriages, Driven with 15 H. P. Motor.

Classes of Direct Current Motors.

Motors may be grouped in two classes—direct-current and alternating-current motors. The direct-current motors might be grouped again in three subdivisions according to the winding of the field magnets, namely: Series-wound, shunt-wound and compound-wound motors. It lies entirely outside the scope of this article to give even a brief outline of the properties of these various types of motors, but this much can be stated here: A series-wound motor has no fixed speed at which it runs; its speed decreases when the load increases. One might say, roughly speaking, that the product of speed and torque (that is, its horse power) is constant. It will start with almost any load, and it races when the load becomes too light. Its speed can be regulated by external resistance, but to do so requires an attendant who constantly watches the load and speed and who controls the resistance accordingly. It is a splendid motor for railroad or crane service, where such an attendant is always at hand; but a machine tool generally requires a motor which should be self-regulating. A series-wound motor, therefore, is ill-adapted for machine tools. There are a few cases, however, where such a motor can be successfully used, for instance, when some part of the machine tool, say, a carriage or tailstock on a long lathe, has to have a quick traverse. The load in this case is practically constant. The speed, therefore, will also be constant. Small variations in the load, on account of differences in the lubrication or wear, will cause slight variations in the speed; but this is immaterial in this case. It would be a mistake to think that a series-wound motor is equally well adapted for traversing parts of machine tools in a vertical plane, such as a cross rail of a planer or a boring mill. The difference in load going up or down is too great.

The shunt-wound motor is self-regulating as to speed; that is, it keeps the same speed whatever may be the load. Like all my other statements about motors this statement is not absolutely true, but it is true enough for practical use. On account of its constant speed the shunt-wound motor is especially well adapted to drive machine tools which run at only one speed, or to drive countershafts. Its main draw-

back is that it has a low starting torque, which, however, is not quite so serious as it looks, as will be seen hereafter. The speed of a shunt-wound motor varies with the voltage; that is, the speed goes up when the voltage goes up, and vice versa. This fact is of very little importance as far as machine tools are concerned, as the fluctuations in voltage in any well-designed power plant are limited to a few per cent. There is one case, however, where this property of the shunt-wound motor becomes of the greatest importance to the machine tool builder, and that is where multiple voltage is used; but of this more later on. The speed of the shunt-wound motor can be changed in two ways: It can be speeded up by inserting resistance in the field winding—in which case the motor remains self-regulating under varying loads—or it can be slowed down by inserting resistance in the armature circuit, in which case it loses its property of self-regulation and behaves to a large extent like a series-wound motor. For this reason this mode of controlling a shunt-wound motor (rheostatic control) is of little use to the machine tool builder.

The compound-wound motor is a cross between the series-wound and the shunt-wound motors. Its fluctuations of speed under varying loads depend on the strength of its series coils as compared to the shunt coils. The same is true of its starting torque; consequently a compound-wound motor which has a large starting torque will also show great fluctuations of speed under a varying load. The compound-wound motor lends itself, therefore, to cases where a relatively large starting torque is required, and where a perfect constancy of speed is not essential; for instance, for the quick traverse of machine parts like the carriage on a lathe or the cross rail on a planer or boring mill, etc.

Alternating Current Motors.

Alternating-current motors might also be divided in three groups, viz.: Synchronous, multiphase and monocyclic. These classes embrace nearly, though not quite, all existing alternating motors. All these motors have a tendency to run in perfect synchronism with the generator or to within a few per cent of that speed, and they may, therefore, be considered as constant-speed motors. The synchronous motor is not well adapted to machine tools, as it is not self-starting. The multiphase and monocyclic motors are self-starting, and have a fairly large starting torque. They do not allow of speed regulation except by cutting out some of the poles or by rheostatic control. I do not know of any alternating-current motor in this country which is specially built with the purpose in view of running it at variable speed.

The above is a crude outline of the limiting qualities of motors. We now must look for the requirements of machine tools, and instead of trying to generalize it may be best to look at the different classes of machine tools as they now exist. Let us first look at the tool most familiar to all of us—the lathe—and especially the engine lathe.

Speed Changes for Motor-driven Lathes.

The ordinary engine lathe, as we all know, is driven by a belt running on a cone pulley, while in all larger sizes back gears are used to get the lower speeds and to increase the pull. This arrangement is very simple; it provides for a large range of speeds, and not only that, but as the speed decreases the pull, or rather the torque, increases. To more clearly show the possible results of such an arrangement we will assume a 24-inch lathe to have a cone, of which the large step is 18 inches in diameter, the small step is 9 inches in diameter, and the back gear ratio is 5 to 1. We will assume the countershaft to make 80 revolutions per minute, and we will further assume that the countershaft cone has the same steps as the machine cone. With this arrangement the lowest speed of the spindle would be 8 R. P. M., which speed is, of course, too high for a 24-inch lathe; but this does not matter here, as the figures have been chosen for illustration only and are not supposed to be used in designing a machine. This lowest speed is obtained by throwing the back gear in and putting the belt on the 18-inch step. If the diameter of the piece to be turned is smaller than 24 inches the belt is shifted from the highest to a lower step, leaving the back gear in mesh. By the time the belt is on the 9-inch step the spindle runs $80 \times \frac{18}{9} \div 5 = 32$ R. P. M. This would be the proper speed for about 6 inches diameter; at least, if 8 R. P. M. is the proper speed for 24 inches diameter. It will be seen, therefore, that, though the ratio between the highest and the lowest step of the cone is only 2 to 1, the ratio of diameters that can be cut by simply shifting the belt is 4 to 1. The belt speed changes when the belt is shifted from one step to the other and is highest when the belt is on the small step, because it is then on the largest step of the counter cone. It will be seen, therefore, that the lathe can do more work with the belt on the small step than with the belt on the large step. However, the torque of the lathe is greatest when the belt is on the large step, because the torque is in right proportion to the diameter of the steps.

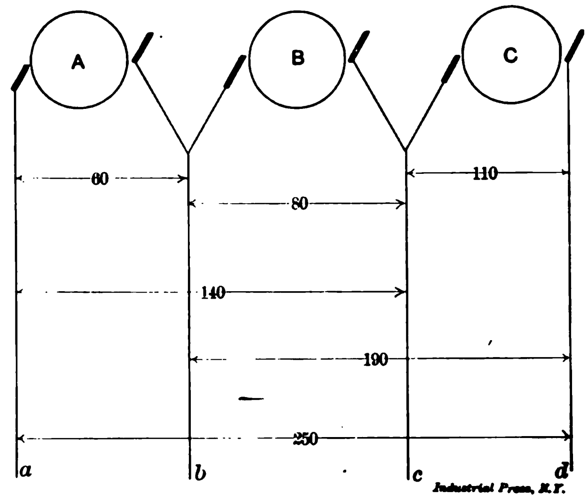


Fig. 2. Arrangement of Wires in Multiple Voltage System.

Let us illustrate this with figures. If this lathe should give a pull of 2,000 pounds on a diameter of 24 inches, then the torque is 2,000 × 12 = 24,000 inch-pounds. The work done by the lathe may be expressed by 8 × 24,000, because the spindle makes 8 R. P. M. When the belt is on the small step its speed is doubled; therefore, the work which can be done by the lathe is doubled, and is, therefore, 16 × 24,000 inch-pounds. The speed of the spindle, at the same time, was increased from 8 to 32 R. P. M.; so that the torque is now 16 × 24,000 ÷ 32 = 12,000 inch-pounds. This torque is available for cutting on a diameter of 6 inches; so that the pull at the circumference of a 6-inch piece is now 12,000 ÷ 3 = 4,000 pounds. This, however, is very much diminished by the increased friction in the lathe when it is run at higher speed. Taking it all in all, a belt and cone pulley are a close approach to an ideal arrangement for driving a lathe, allowing the lathe to run at speeds corresponding to the diameters to be turned and giving the greater torque for the larger piece.

Now, what kind of motor would we have to use if we should build it in the headstock of a lathe, making it take the place of a cone pulley? This motor would have to be a variable-speed motor, the lowest speed to be 40 R. P. M. and the highest 160 R. P. M. Its torque at the low speed must be four times greater than at the high speed, so as to give the same circumferential pull on any diameter we may wish to turn. Such a motor and the millennium are two things to be wished for, but neither of the two is at hand.

A series-wound motor seems to fulfill all the conditions, but it would race whenever the load is taken off. If we had a piece in the lathe which requires a perfectly even cut such a motor could be used, and the operator would use a controller and set it in a position for the proper speed, which speed would then be constant, as the load is constant; but if the cut were uneven, the operator would have to work his controller lever all the time to keep the lathe from running too slow when taking a heavy cut, or from racing and burning up his tool when the cut is light. But, worst of all, the greatest watchfulness of the operator would not help him when the tool is cutting metal on only part of the circumference and air the rest of the time. The lathe would gather up speed during its idle period, and the piece would run up

against the tool with such a velocity as to knock the tool, the lathe and everything else to splinters. I have been told that a certain lathe maker in this country once heard of the fine qualities of the series-wound motor and forthwith proceeded to build ten lathes with a series-wound motor incorporated in the headstock. This happened about three years ago. The ten lathes are still for sale, and any reliable party can have a motor-driven lathe, or a lathe without a motor, or a motor without a lathe cheap.

A shunt-wound motor is as steady as a Dutchman and almost equally inflexible. A well-made motor of this type does not vary its speed more than 10 per cent from full load to no load. It is a splendid motor to put in the headstock of a lathe in which you do not want to cut more than one kind of a piece and of one diameter. It also allows of speed control; that is to say, if your motor is designed to run at, say, 600 R. P. M., it is possible to make this motor run at practically any speed above or below 600 R. P. M. by means of controlling apparatus outside the motor. You put resistance in the shunt field circuit to make it run faster, or in the armature circuit to make it run slower. There are, however, reasons why this cannot be applied in a general way to machine tools. As everybody knows, the brushes of a motor are once set and then remain forever in that position. It is the position in which the motor is free from sparking. The present-day motors are all made with a field, which is relatively very strong as compared to the armature; that is to say, considering both field and armature as electro-magnets, the field is a very much stronger magnet than the armature. For this reason the greatest variations in current flowing through the armature have but little effect on the field; and the brushes, therefore, do not need to be shifted with the varying load. If we now insert resistance in the field circuit, and thus weaken the field, then the conditions mentioned above are changed. The field is not strong any more, as compared to the armature; the brushes ought to have been shifted, and fluctuations of the load (that is, fluctuations of the armature current) require ever-changing positions of the brushes, which, of course, cannot be complied with, and the result will be sparking. Most present-day motors allow of a field regulation of from 20 to 30 per cent; that is, it is possible to run the motor at a speed which may be from 20 to 30 per cent higher than the rated speed by means of resistance in the field circuit. Greater variations will cause bad results. These 20 or 30 per cent may be split up in as many steps as one desires by splitting the resistance in a number of parts and furnishing the rheostat with a corresponding number of contact buttons. It must be remarked here that it is *possible* to get much greater speed regulations than 20 or 30 per cent, but not with an ordinary commercial motor. There are motors in existence which allow of a field regulation of 50, 75 or even 100 per cent; such motors, however, are very much larger than an ordinary motor of the same horse power, and, of course, correspondingly higher in price. I have in mind a 15 horse power motor which had a field regulation of 100 per cent, and which had a frame of a 50 horse power motor.

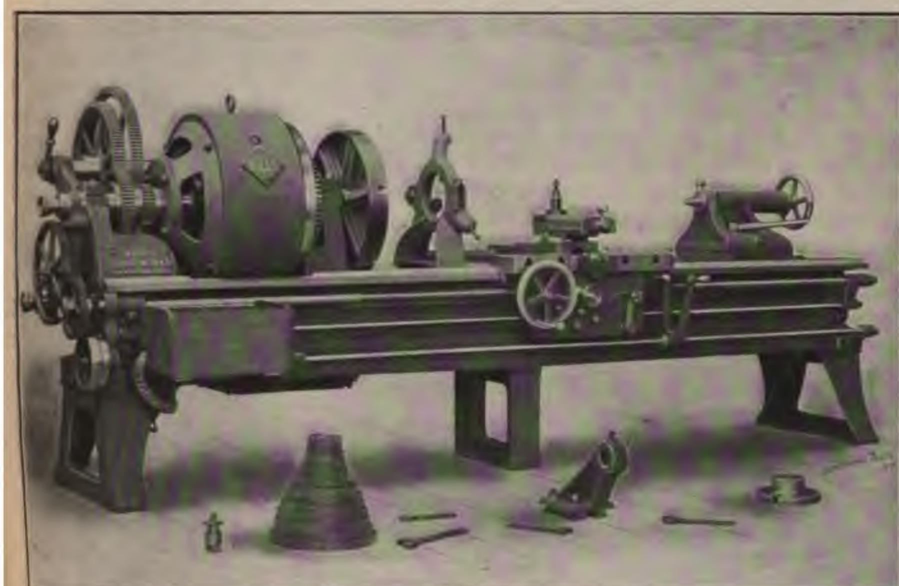


Fig. 3. Twenty-four inch Lathe with Variable Speed Motor.

Armature regulation is generally a very unsatisfactory way of varying the speed of a motor. Inserting resistance in the armature circuit lowers the speed of the motor, but it also makes the motor lose its most desirable quality—steadfastness of speed under varying loads. For instance: Suppose you have a motor which runs at 600 R. P. M. and takes 40 amperes at full load. This motor will run at practically the same speed, whether you use 40 or 4, or any other number of amperes. Now suppose you insert so much resistance in the armature circuit that the speed is reduced to 300 R. P. M.; when the motor takes 40 amperes then the speed will go up as soon as the load is diminished, or as soon as the motor takes any number of amperes less than 40. In other words, it behaves to a certain extent like a series-wound motor, and for this reason becomes unfit to drive a lathe.

Multiple Voltage System.

There is one way of changing the speed of a motor which has not so many disadvantages. It is a well-known fact that when the voltage of the line is changed the speed of the motor changes correspondingly, and practically, in right proportion to the voltage. For instance, a motor which would run 300 R. P. M. when supplied with 100 volts would run 600 R. P. M. when supplied with 220 volts. If it were possible, then, to quickly change the voltage of the line without disturbing other machines the problem of varying the speed of a motor would be solved. This, however, cannot be done, but the system known as "multiple voltage system" accomplishes the same result, and is based on the principle of varying the voltage. This system provides a number of voltages by using a number of dynamos, each with one or two commutators, and each supplying a different voltage. The Bullock Mfg. Co., of Cincinnati, O., is identified with this system, though of late other manufacturers of electrical machinery have also started on the same lines. The voltages supplied by the Bullock system are generally as follows: 60, 80, 110, 140, 190, 250, though other voltages can be furnished just as well. Four wires are needed, which are led to a controller that combines the wires in such a manner as to give the six voltages named above. The generators really furnish only three voltages, i. e., 60, 80, and 110. Fig. 2 shows the arrangement of wires as coming from the dynamos. It is, of course, immaterial whether three dynamos, each with one commutator, are used, or two dynamos, one of which has two commutators, while the other has only one. The three commutators of the three dynamos are represented by *a*, *b* and *c*. The wiring shows that it is possible to run *a* and *b*, or *b* and *c*, or *a*, *b* and *c* in series. This gives three voltages, besides the voltages which can be had by using each of the three dynamos singly. The controller is so arranged that two of the four wires are led to the motor—*a* and *b*, 60 volts; or *b* and *c*, 80 volts; or *c* and *d*, 110 volts; or *a* and *c*, 140 volts; or *b* and *d*, 190 volts; or *a* and *d*, 250 volts. Two hundred and fifty volts are used for the field. As the voltage for the field is constant, and the armature voltage is variable, it follows that the motor does not exactly behave as a shunt-wound motor, or, in other words, its speed is not constant under varying loads. The variations in speed are, however, so small as to offer no practical objection for machine tool work.

It is possible to extend the range of speeds due to the different voltages by field regulation. Adding 30 per cent to the range of speeds already obtained this range becomes 60 to 333, or more than 5½ to 1. This field regulation serves

another purpose besides extending the range of speeds; it allows the operator to obtain practically any speeds between the steps due to the different voltages. Applied to the lathe this means that the lathe hand can get the proper speed for any diameter, or change his speed gradually when facing.

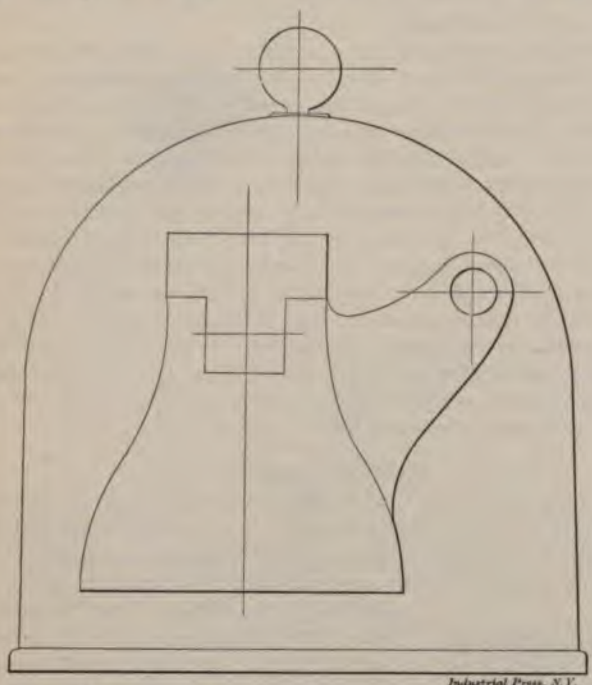


Fig. 4. Outline of Variable Speed Motor and Lathe Headstock.

Fig. 3 shows a 24-inch Niles lathe driven by a Bullock variable-speed motor (multiple voltage). In this case the motor is built into the headstock, the outside of the motor being turned and the headstock being bored out as a seat for the motor. The controller can be seen at the left-hand end of the bed. A splined rod, extending along the front of the lathe and operated by a lever which moves with the carriage, serves to operate the controller. The motor is reversible. It will be seen that there are two sliding gears on the back gear shaft which extend the range of speeds obtained by the motor. An arrangement of this kind is neat and handy and very economical, as the operator need not hesitate to change his speed whenever he thinks it advisable to do so. Like all other good things, however, this arrangement has its drawbacks also. In the first place, this method of driving a lathe cannot be applied unless the shop is supplied with more than one voltage. In the second place, a motor like the one shown here is not a piece of standard apparatus, so that repairs cannot easily be had. The first objection is not quite so formidable as it appears at first glance. Any shop which possesses an electrical generating plant can arrange for the multiple-voltage system by installing what is known as a rotary converter, or booster, or balancer. This apparatus splits the voltage, or rather uses the voltage at hand, and produces the voltages required. It might not pay to install such a converter for only one tool, but where a number of tools have to be driven it certainly is cheaper to buy a converter than to throw out the old dynamos and install new ones. Such a rotary converter does not always need to have a capacity equal to the horse power of all the tools to be driven, as it is natural that at least some of the tools will be using the original shop voltage. A rotary converter is also to be recommended where a large proportion of the power is used for lighting, or for cranes, and only a small portion for driving the machine tools. Some makers of electrical machinery use only two voltages; for instance, 110 and 220, and fill the gap between the two speeds by field regulation. This necessarily makes the motor excessively large.

Fig. 4 shows an outline of a motor which was to drive a 24-inch lathe, the headstock of which is shown in the same sketch. Both outlines are drawn to the same scale. The cut shows clearly one of the difficulties the machine tool designer has to deal with when he attempts to connect a variable-speed motor to a lathe. The size of a motor of given horse power is a quantity which varies between very wide limits. It is no exaggeration to say that one motor maker makes every dimension 50 per cent larger than another, and, therefore, while it is possible to use some kinds of motors for direct drive, it is entirely unpractical to use a motor of some other maker. I am not writing advertisements for any one electrical concern just now, nor criticism of any other one, and so I leave the names of the successful as well as of the unsuccessful motor makers unwritten. It seems rather strange to the outsider that there should be such a difference, and I am not prepared to explain the fact; I know, however, that the fact exists and that this is one of the reasons why

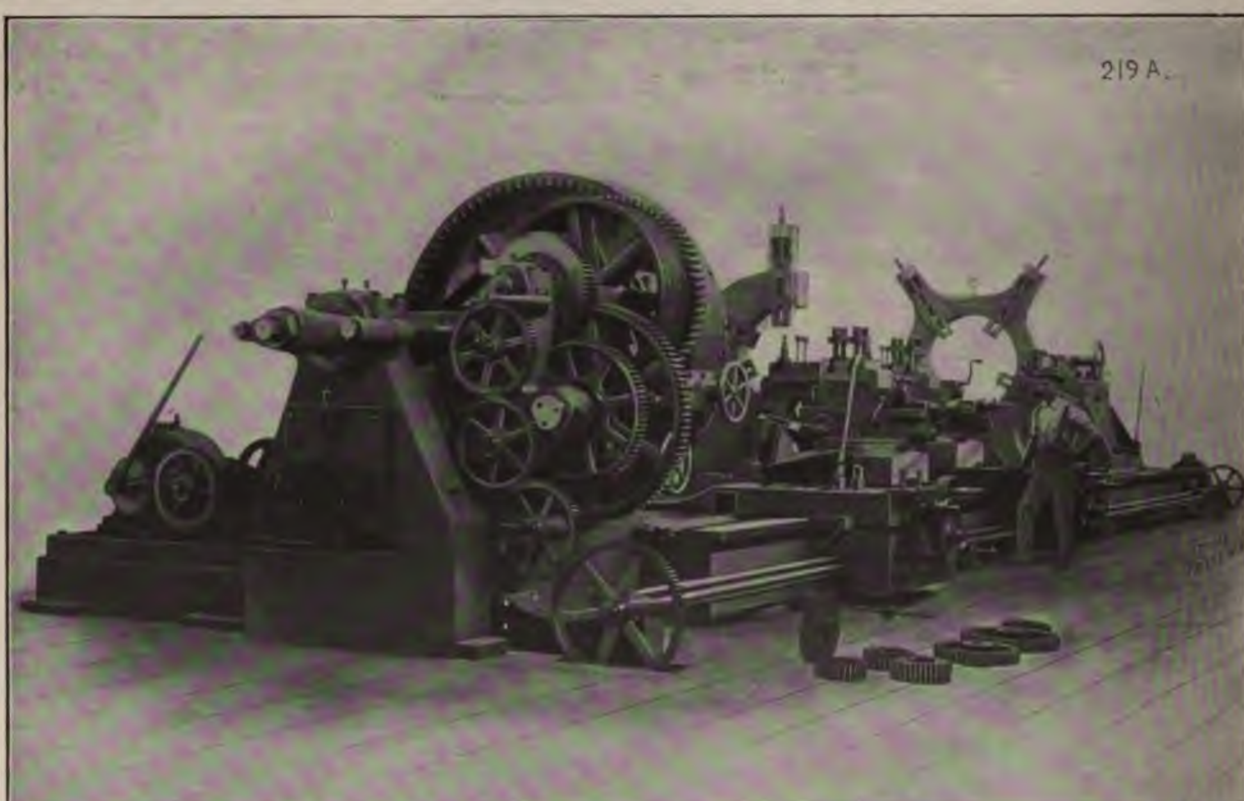


Fig. 5. Ninety-inch Crankshaft Lathe with Constant Speed Motor with Speed Changes by Means of Gears.

mpossible to standardize electric drives for machine

re I mention any other mode of driving a lathe by of a motor I want to say a few words about the results n obtain with multiple voltage. As the torque of a e-voltage motor is constant it follows that the horse increases with the speed, and that the term of, say, 10 power has no meaning unless one states at which the motor is supposed to develop 10 horse power. It llows that the same torque is always available, whatliameter one wants to turn; and that, therefore, the

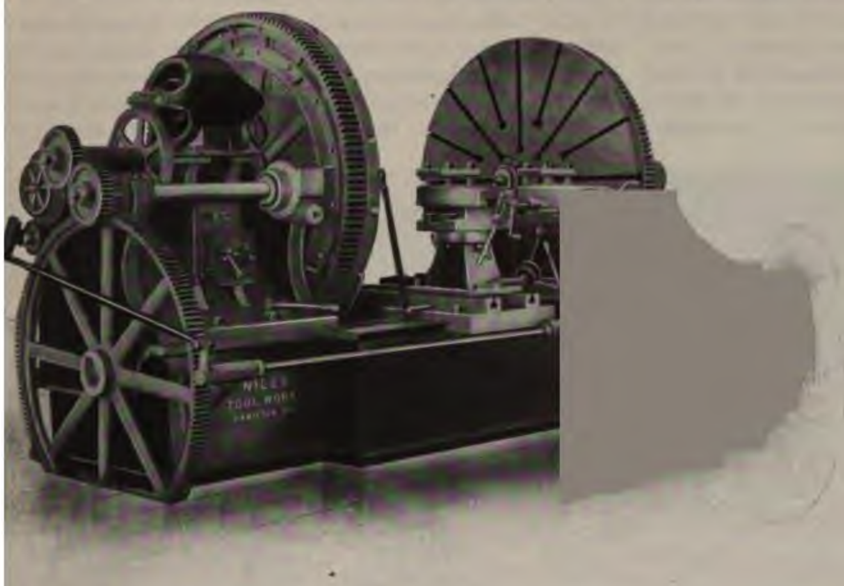


Fig. 6. Driving Wheel Lathe with Constant Speed Motor.

le pressure at the tool point becomes greater the the diameter. Suppose, for instance, you have a which runs from 240 to 1,200 R. P. M., and that this develops 2 horse power at the lowest speed. Suppose e this motor on a 24-inch lathe, and that you turn iece 24 inches in diameter. What will be the pressure point of the tool under these conditions? As 1 horse equals 33,000 foot-pounds, 2 horse power gives 66,000 unds. Suppose you are cutting at a speed of 20 feet ite; then the pressure at the point of the tool will be ÷ 20 = 3,300 pounds. Now, when you want to turn iece 12 inches in diameter, you must run your lathe is fast, and, therefore, the motor must run 480 R. P. M. otor develops at that speed 4 horse power, or 132,000 unds; and, as the cutting speed is again 20 feet, the re at the tool point is now 132,000 ÷ 20 = 6,600 pounds. ct that the pressure becomes greater when the diameter s less is of no use, except in so far as it serves to overthe greater friction in the lathe, due to the higher In other words, the motor is sometimes just large , but more often much larger than you want it. There wever, another side to this story. It is sometimes ble to run the lathe at higher speeds than it is defor. For instance, when using some self-hardening or tools, which allows to cut at much higher speeds— aylor-White steel, for instance, for cutting steel. If y to do this on the ordinary lathe, by shifting the belt two steps lower down on the cone, or by throwing ck gear out, you will find that the lathe has the proper it is true, but not power enough to pull the cut. The hing left, then, is to speed up the countershaft. This, er, is a nuisance, to put it mildly, and, besides, gives high speed to pulleys and cones that it is only practical very narrow limits. It is an entirely different matter, er, with a lathe driven by a multiple-voltage motor. er you cut your piece at a cutting speed of 20, 30, 60, feet you always have the same torque, and, therefore, g as you do not change the diameter, the same pressure point of the tool.

1 shows a view of a 63-inch lathe which has four ges—two in front and two in the rear—built by the Niles Tool Works Co., and which is driven by a 15 horse power motor geared to a cone. This cone, with the motor, is placed on a carriage or slide which allows of slacking the belt when the belt has to be shifted. It will be noticed in this machine that the cone is at right angles to the axis of the lathe. This was made necessary by the fact that a worm and wormwheel were introduced in the drive.

In Fig. 5 is an illustration of a 90-inch crankshaft finishing lathe of extra heavy design. The motor used for this machine was of constant speed, and the necessary speed variations were provided for by means of change gears, that can be seen at the extreme left of Fig. 5. A pulley, visible in the headstock, was keyed to the second change gear shaft, which drove the large pulley, and there is a second motor at the extreme right, which was used for the quick traverse of the carriage. Although this does not properly belong to a description of electric drives, it may perhaps be remarked here that the lathe had two carriages, each of which was entirely independent of the other; that is, each one could feed in either direction, or stand still, or traverse quickly in either direction, or have a fine or coarse feed, no matter what the other carriage was doing at the same time. It may further be noticed that all movements of the carriage, as well as of the compound rest, can be controlled by a man standing on the carriage, as is necessary with a lathe of so large a swing.

Fig. 6 illustrates a driving wheel lathe of heavy pattern which is driven by a constant-speed motor, the various speeds being obtained by means of change gears at the end of the headstock. As one of the objects of the electric drive of machine tools is to do away with all overhead works it was necessary in this lathe to change the usual feed arrangement, which, as is well known, is by means of an overhead rocker shaft in lathes of this type. All the lathes shown in the accompanying illustrations are built by the Niles Tool Works Co.

* * *

SUGGESTIONS TO ENGINE BUYERS.

A simple horizontal throttling slide-valve engine is to be recommended for low first cost, cheap fuel, small floor space, small operating skill required, medium or high speed.

A horizontal throttling compound slide-valve engine is to be recommended for medium first cost, fair economy, medium floor space, for pressures of 90 pounds and upward, small ability for operating, medium or high speed.

A simple Corliss is to be recommended for medium first cost, good economy, slow speed, long but narrow floor space, 70 to 125 pounds pressure. Requires fair operating ability.

A compound Corliss non-condensing engine at high first cost, gives good economy with steady loads, and is to be recommended for large floor space, pressures of from 110 to 160 pounds, first-class ability for operating, slow speed.

A compound Corliss condensing engine, at high first cost, is to be recommended for the best attainable economy, with boiler pressures of from 90 to 160 pounds, for first-class operating ability, slow speed and plenty of room.—From Lane & Bodley's Catalogue.

* * *

HE WAS A MACHINIST.

A very stylish lady entered a crowded street car in Cincinnati one evening at 9 P. M. A plain but clean workingman immediately got up and offered her his seat. He discovered, however, that she was not lady enough to thank him for the attention, but took the seat as if it were hers by right. Thereupon he asked her to let him see if he had left his handkerchief in the seat, and when she rose, he sat down again. She got off at the next stop, and some were heard to exclaim that "it served her right." The man wore a twist drill on his chain.

H. L. C.

MODERN ENGINE BUILDING.

NOTES TAKEN AT THE SHOPS OF THE WESTINGHOUSE MACHINE COMPANY.

Geographically, and by lapse of years, it is a far cry from the old engine shop of James Watt, at Soho, England, to a modern engine-building plant like that of the Westinghouse Machine Co., at East Pittsburg, Pa. Yet probably as relatively great is the gulf separating the primitive engines and tools used for their production in the time of Watt from the modern engines and machine tools and appliances to be seen in the Westinghouse shops to-day. The concrete result of a century of continued improvement in steam engine design, in machine tool development and in shop practice is embodied in the manufacture of the best modern steam engines.

The shops of the Westinghouse Machine Co., built in 1895, are located on the main line of the Pennsylvania R. R., in the center of the iron and steel industry of the United States. In the immediate vicinity are immense deposits of bituminous coal, from which coke is made in great quantities. Natural gas is also found in near-by fields and has been largely used in manufacturing, although the decreasing gas pressure has led to its abandonment in general. In many individual instances, however, it is still used. Gas wells are located on the Westinghouse property, and the gas is used for the operation of gas engines and for other purposes.

The plan of the main shop is that of two central bays, 1,200 feet long by 230 feet wide, served by traveling cranes, with galleries at the sides and in the center between the bays. The scheme for power distribution is that of electrical transmission from one central station. Alternating-current polyphase motors are used in all cases, including those for the traveling cranes. The general plan for the smaller machines is to group them and to drive them from a motor-driven line shaft. A few of the larger, however, are driven by individual motors. The sections of line shaft are generally driven by motors located on the floor for convenience in attention, power being transmitted to the line shaft by belting. The plan of grouping of machines like planers is to arrange them so as to get as nearly as possible a constant load. Thus in the planer department there are six planers driven by one motor. They range in size from 48 inches for the smallest to a Pond planer which takes in 14 feet between the housings and 10 feet 7 inches under the cross-rail.

The boiler equipment in the power house is Babcock & Wilcox. The boiler furnaces are fed by Roney stokers. The engine room contains five compound steam engines aggregating 1,000 horse power and seven gas engines aggregating 915 horse power. Most of these engines are direct-connected to electric generators, and all the apparatus is of the Westinghouse type. The power equipment is housed in the same building with the blacksmith shop and the warehouse. The space between this building and the machine shop is taken up by a railway switch and a 50-ton Gantry crane. This crane serves the entire space between the two buildings and runs on rails laid on ties the same as the railway tracks.

The foundry is a continuation of the north bay of the machine shop, the space between it and the south bay of the machine shop being utilized as pattern storage. The sand, coke, coal and iron are run in beside the foundry on a railway switch located directly beneath the storage bins at the side of the building. The foundry is served by electric traveling cranes supplemented by smaller wall, post and jib cranes. Labor-saving devices and appliances such as power sand sifters, etc., are quite generally employed. The castings, uniformly made in green sand with green sand cores,

Fig. 1. North Bay of Machine Shop looking towards the Foundry.

are remarkable for their smoothness, freedom from blow holes and truth to pattern, a result due, in great measure, to the rigid inspection which all materials are required to pass. Analyses are made in the laboratory to determine the chemical qualities of the material entering into every heat. Standard test bars are made and broken, and records made of each test.

The pattern shop lies adjacent to the foundry. At the opposite end from the foundry and on the same side of the machine shop are the offices, separated from the machine shop by a division wall pierced by many windows, as indicated in Fig. 5. This view shows the division wall back of the large lathe. The executive offices are on the first floor, and the drafting rooms on the second and third floors. There is also on the third floor a lunch room where the foremen, draftsmen, clerks and officers eat their mid-day meal.

Both steam and gas engines are built, the former in sizes ranging from 5 to 6,000 horse power, and the latter in various sizes from 10 to 650 horse power. The Westinghouse steam engine is too widely known to require description. The gas engine is built on the same general lines, and the same methods of manufacture are followed in the construction of each type. All work is made strictly interchangeable. The shop equipment comprises a complete assortment of jigs, fixtures and gages such as are generally used in interchangeable manufacture. This system has been in vogue with the company for so long a time that it has entirely lost all novelty and is regarded as a matter of course. Not less complete is the system of inspection. The inspectors are clothed with authority, which makes their decisions not subject to reversal, and consequently they are held responsible for results. The inspection system extends to making the measurements and passing on the allowances for press and shrink fits. Their experience and judgment in this difficult feature of machine construction is assisted by what is probably one of the most complete records of press and shrink fits in the country. To facilitate the measurement of large shafts special micrometer calipers have been designed and made which were illustrated and described in the July, 1901, issue by Mr. J. B. Thomas. These calipers are of such a form as to make deflection a minimum, and all measurements and comparisons to the standard length gages are made with the calipers in a vertical position. A special fixture supports the weights while measurements are taken, so that the influence of having to support the caliper in the hands is removed, which enables all the inspector's attention to be directed to getting the delicate touch necessary to accurate measurement.

The building of the steam and gas engines on the interchangeable plan and the general policy of the company, bring nearly all the repair work their way. Instead of charging an exorbitant price for repair parts, these are furnished to customers on the same equitable cost basis as the complete engines. Consequently it is usually cheaper to buy repair parts from the company than to have them made in local shops. Since most of the repair parts are made and sold by the company they are enabled to keep a complete record of the endurance of almost all engines sold. Those repair parts which have been much called for have speedily become the subject of scrutiny as to design and material, and, where possible, steps have been taken to make them more durable. Some surprising facts are disclosed by a study of the records of engines made and sold years ago. Many that are known to have been practically in constant use, and for which all the repair parts have been furnished, show a trifling repair bill.

The greater portion of all repair parts needed for the many thousand Westinghouse engines are supplied by the company and hence this part of their business is not unimportant. It has been systematized so that the furnishing of a repair part is accomplished at a minimum of expense. The crankshafts for the regular line of steam engines are

Fig. 2. Erection Shop, looking toward the Testing Department. Traveling Crane of this Section has Clearance of Sixty Feet Beneath the Hook.

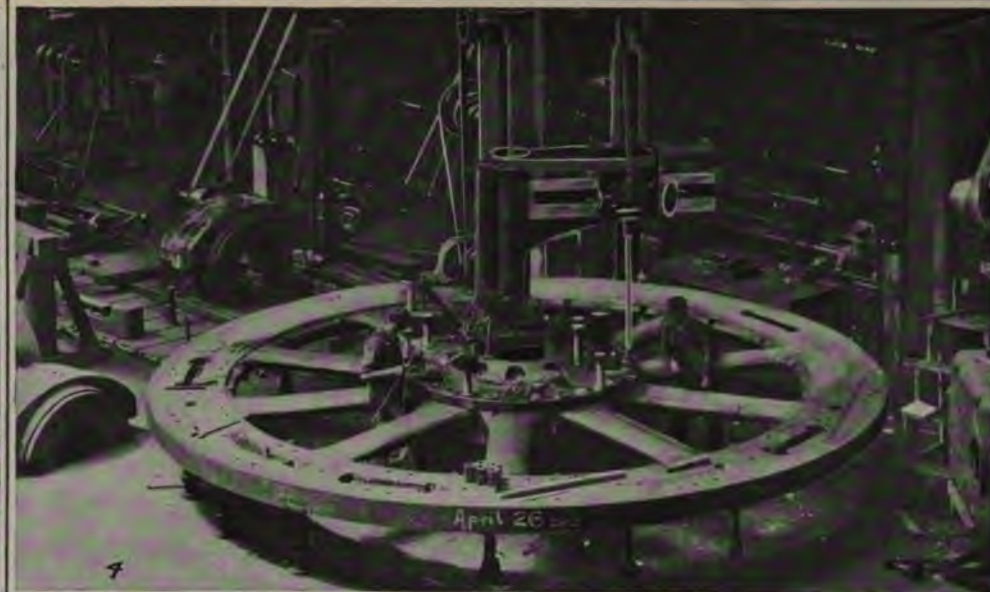


Fig. 3. Row of Housings for 43 1-2 inch and 75 1-2 inch and 75 1-2 x 60 inch engines for the New York Edison Co.

Fig. 5. Turning Shafts for 4,500 H. P. Engines for Edison Electric Illuminating Co. of Brooklyn. Length, 28 feet; maximum diameter, 39 inches; weight, 36 tons; Shaft hollow; diameter of hole, 16 inches.

Fig. 4. Building a Twenty-three Foot Flywheel. Five Circular Plates are Riveted on each side of the Rim. Rim and Plates held together by Shrunk-in I-links.

Fig. 6. Facing Off top of Housing in Sellers twenty-eight foot Boring Mill.

ınder heavy steam hammers, ranging in size from ; down. The shafts are forged out as indicated at g. 14, in which shape they are taken to the machine The heavy stock between the cranks is removed by and slotting as shown at *B*. After this the machine ns are confined to the lathe. The three-throw cranks for the three-cylinder gas engines are built up of ɪrgings. The end sections are forged each with one he same as indicated in the case of the two-throw The middle crank is a separate forging comprising crank cheeks and crank pin.

ıistons of the standard engines are fitted with snap hich are most carefully made. They are turned and rom the casting in about the ordinary manner. After ıt off they are cut apart and then the sides are ground ıe ring is compressed to the same degree as it will in the cylinder. In this manner it is possible to get h surface and to have all parts of a ring of uniform

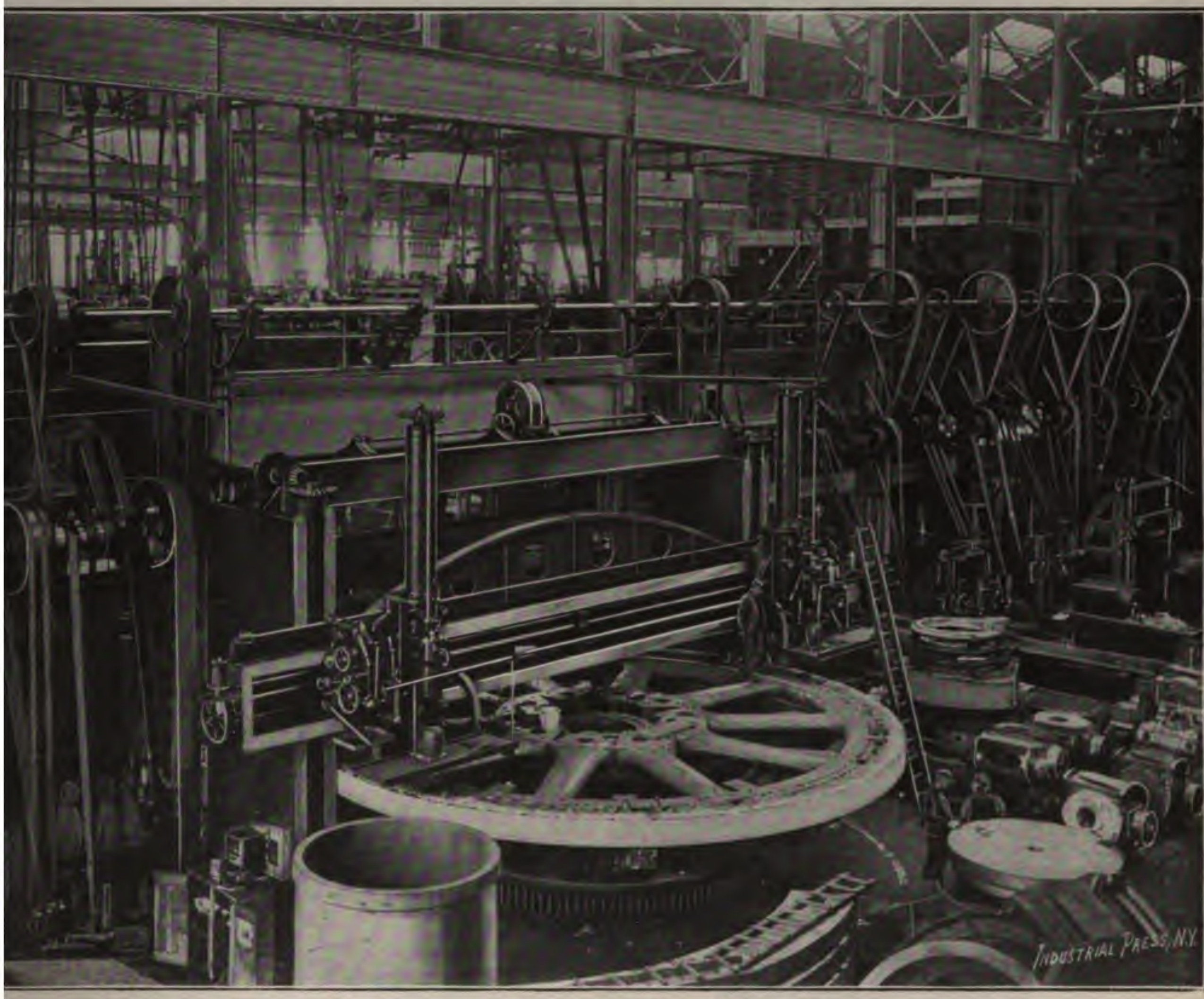


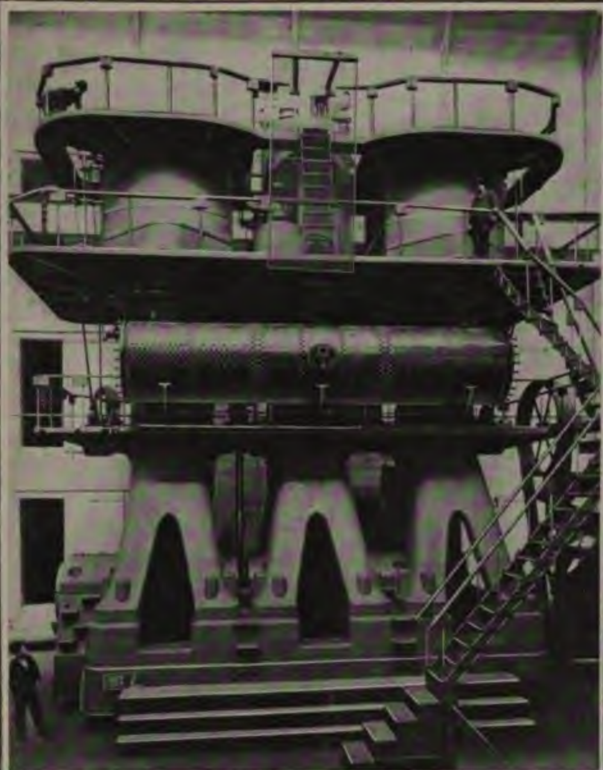
Fig. 7. Turning Twenty-eight Foot Flywheel on Sellers Boring Mill for 4500 H. P. Engines.

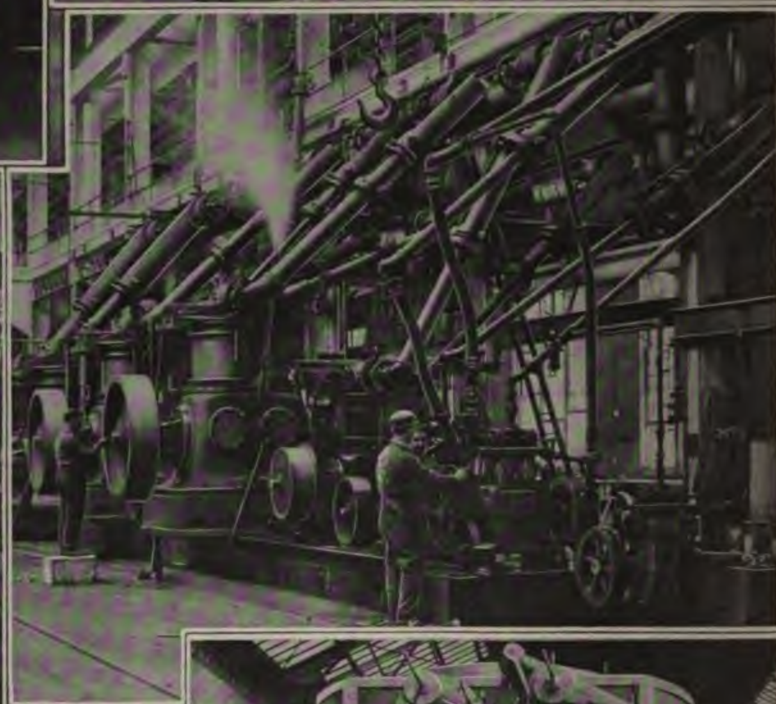
ıs, which would not be the case if the ring were ground xpanded form or when uncut. The grinding is done ling machines which have been rigged up for the purd fitted with magnetic chucks for holding the rings ion. The rings being held in position by magnetic ɔn, no clamping is necessary. The grinding is rapidly a most accurate manner.

ıgines except the largest are subjected to a running ore they are shipped. At the time of the writer's th steam and gas engines were being tested of varyıs from the smallest of 5 horse power up to steam of 500 horse power. One of the latter size being tested ertical compound engine for the new Union Station ennsylvania R. R. system at Pittsburg, Pa. The conn of steam by the testing department is, of course, able. Often there will be a dozen or more engines ɔus sizes running at full load while restrained by Prony brakes. Large surface condensers are provided near the testing block with weighing tanks beneath, so that the matter of determining water consumption is readily done with a minimum of labor. A system of telescopic pipe connections is provided for readily connecting up the steam and exhaust pipes of the engines to be tested.

The present era of large central station building has led to the building of steam engines of enormous proportions. The Westinghouse Machine Co. are now engaged in the construction of eight superheated steam engines of 6,000 horse power each for the new power plant of the New York Edison Co., at 38th St. and East River, New York. They are also engaged on eight 5,000 horse power engines for the Third Avenue R. R. Co., New York, and on two 4,500 horse power engines for the Boston Elevated Railway. The engines recently built for the Edison Electric Illuminating Co., of Brooklyn, were rated at 5,000 horse power. All these engines are of the vertical compound type, direct-connected to electric generators. The accompanying illustrations show some interesting views taken in the works during the progress of work on these immense prime movers. Photographs are taken at frequent intervals, and thus constitute a faithful record of the progress of work. Such a record is most convenient for reference, as it tells so much at a glance that could be sifted from written records only at the expense of much time and labor.

Fig. 1 is a general view of the north bay of the shop looking toward the foundry. At this end of the shop are located some heavy machine tools. At the left in the foreground is a Sellers 28-foot boring mill. This machine, also shown in Figs. 6 and 7, is of slightly different design from the one in the works of the Westinghouse Electric & Mfg. Co., illustrated in the October issue. At this end of the shop (but not shown) is a Pond rotary planer having two cutter heads, one of which is adjustable on the table relative to the other.





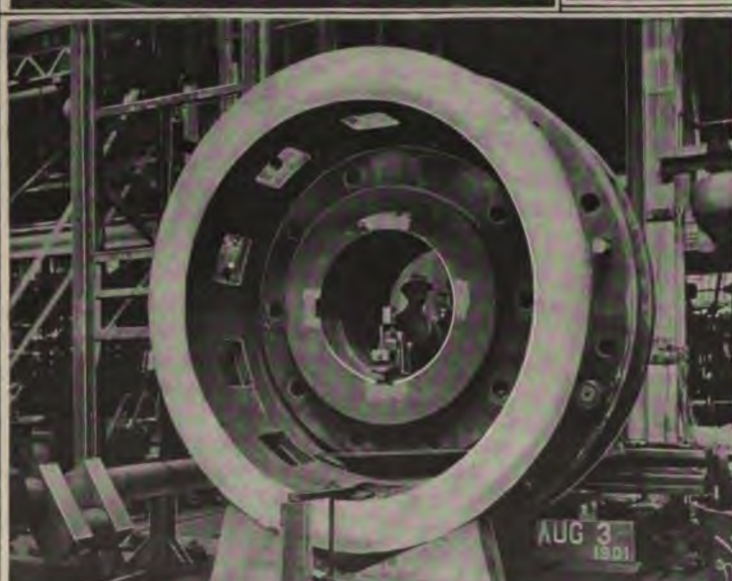


Fig. 8. Superheated Steam Engine of 6000 H. P. for New York Edison Company.
Fig. 10. Special Boring Bar Boring Spherical Seat in Pillow Block.
Fig. 12. Cutting Keyseats in Hub of Large Flywheel, using a Morton Draw-cut Shaper.

Fig. 9. View showing comparative size of Low-pressure Cylinder for Boston Elevated 5000 H.P. Engines and of a Man.
Fig. 11. Testing Department.
Fig. 13. Valve Gear for High-pressure Cylinder for 4500 H. P. Engine.

The table or floorplate is about 20 feet square. This machine is principally used for milling off the ends of flywheel segments. Near this tool is a boring mill used for boring cylinders. The practice is to bore the cylinders in a vertical position on the boring mill and revolve the cylinder, which is contrary to the more usual practice of revolving the boring bar in the cylinder while stationary. Further up this aisle is a Bement, Miles & Co. 125-inch lathe, shown in Fig. 5 with a shaft in the lathe for one of the engines for the Edison Electric Illuminating Co., Brooklyn, N. Y. This shaft weighs 36 tons finished, and is about 28 feet long. It is hollow, having a 16-inch hole throughout. Its maximum diameter is 39 inches. Such large and heavy shafts are not permitted to bear on the centers of the lathe with their full weight, as this would cause excessive wear of both the centers and the plugs in the shaft. A rest is provided near each end which carries nearly all the weight and so relieves the centers. The shaft is carried on hardened steel centers secured in cast-iron plugs forced into the hole. All the shafts are turned and finished with great care. After having been turned they are ground by an emery wheel attachment mounted on the tool carriage and driven by an electric motor. The crank disks for these shafts are bored and scraped to plug gages which are made with the proper force fit allowance, as prescribed by the inspection department.

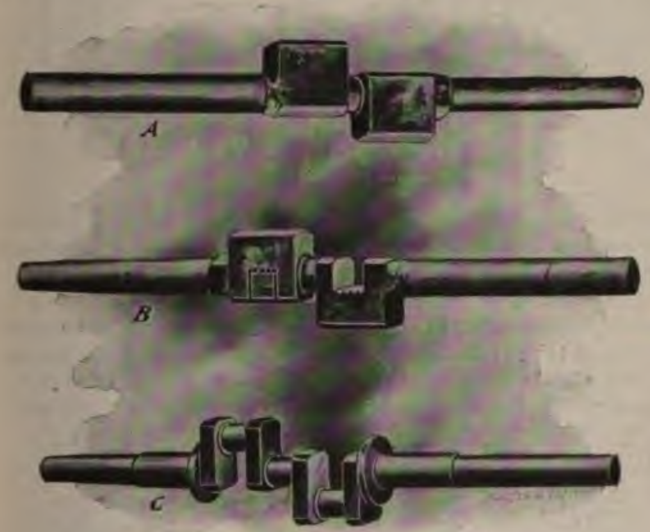


Fig. 14. Method of Machining Crankshafts.

A view of the erection shop is given in Fig. 2, which shows the erection of some of the large engines for the New York Edison Co. The traveling crane for this department has a clearance of 60 feet beneath the hook. The type of flywheel used on the large engines recently built is shown in Figs. 4 and 7. The flywheel shown in Fig. 4 is 23 feet in diameter and is made of five sections, the rim of each having an angular length of 72 degrees, a depth of 30 inches, and a thickness of 9 inches. The ends of the sections are held together by I-links shrunk into place, and each of the two arms of each section is held to the hub by three bolts. On each side of the flywheel rim are riveted five segmental plates, each ¾ inch thick, which makes the total width of the rim 16½ inches. The side sections are also bound together by "shrunk in" I-links, and are so arranged that joints are broken so that no two joints come opposite. This wheel is designed for a peripheral speed of more than one mile a minute (5,419 feet). The flywheel shown in Fig. 7 is substantially of the same design but is larger, being 28 feet in diameter. The plan of taking the tools to the work is illustrated in the case of the flywheel in Fig. 4. A radial drill is clamped on the wheel and employed for drilling, reaming and boring. Another portable tool is that shown in Fig. 10. The illustration shows a special boring bar boring a spherical seat for the shaft bearings, which makes them self-adjusting. The boring bar carries a radial arm on which is mounted the cutting tool. The tool swings in the arc of a circle and thus generates a spherical surface as the bar turns. The bar is mounted on a large flat casting which is set on top of the pillow block, as shown. In other cases the cylindrical seats for bearings are bored by an ordinary boring bar having a traveling head.

Another noticeable tool is the Morton draw-cut shaper shown cutting a keyseat in the flywheel hub of a 6,000 horse power engine. A feature about this hub is that it has a four-step bearing on the shaft. The four successive diameters are plainly visible in the bore of the hub. The practical advantage of this construction is that the hub has to be pressed onto the shaft only one-fourth as far as would be necessary for a plain cylindrical fit. Not having to be pressed so far the surfaces are not so likely to be abraded. The experience of some European builders seems to indicate that such a fit has considerably more holding power for the same degree of applied pressure than the plain cylindrical fit. Fig. 8 shows one of these engines as erected in the shop. The practice is to assemble these large engines complete, with the exception of the flywheel and shaft. In place of the flywheel shaft a dummy shaft is mounted concentric in the shaft bearings, and on it are mounted the eccentrics. The valve motion is erected complete, and driven from the dummy shaft by an electric motor. In this way it is possible to make all adjustments of the valve gear and governor so that when the engine is finally erected it is ready for work. In the case of the engine shown in Fig. 8 the eccentrics are carried on a lay shaft about on a level with the first platform. This lay shaft is driven from the main shaft by spiral gears. The aim in this design is to do away with the necessity for the enormous eccentrics that would be required on the main shaft. Eccentrics of such large size absorb a great deal of power because of their large peripheries. During the shop erecting the lay shaft is driven by a motor and the valve motion adjusted and worn to working conditions.

The valves for the high-pressure cylinder of these engines are of the double beat poppet type. There are two admission and two exhaust valves. The valves for the low-pressure cylinders are of the Corliss type and are placed in the top and bottom cylinder heads. This position makes possible a great reduction in port length and a consequent reduction in the clearance volume. The cylinder shown in Fig. 9, intended for the Boston Elevated Railway Co., is of the same construction. The cored opening at one side of the bore is for the steam inlet, and that on the opposite side for the exhaust.

* * *

ARE WE APPROACHING SOCIALISM?

The United States is operating a railroad of its own, and does not make a cent out of it from one year's end to the other. Only a few miles from New York, on the Sandy Hook peninsula, is a six-mile steam railroad with Fort Hancock as one terminal and Highland Beach as the other. This road, while limited in its rolling stock to one locomotive, one combination baggage and passenger car, and several freight cars, is in touch with the whole country, as it connects at Highland Beach with the Central Railroad of New Jersey. Large operations in the line of ordnance tests are secretly conducted at the Sandy Hook proving grounds, by the Ordnance Department at Sandy Hook, and it is the transportation of this ordnance, together with ammunition and supplies, that furnishes the bulk of business of this railroad. The passenger traffic is small, as it is limited to those having passes issued by the military authorities of the United States. Aside from the inscription, "Sandy Hook Proving Grounds," which appears on the cars and locomotives, there is nothing about the train to suggest the ownership of the road. Nevertheless, it is Uncle Sam's own railroad, with an artillery sergeant as conductor and a competent traffic manager, Colonel J. B. Burbank, who is at present in command at Fort Hancock.—*American Engineer.*

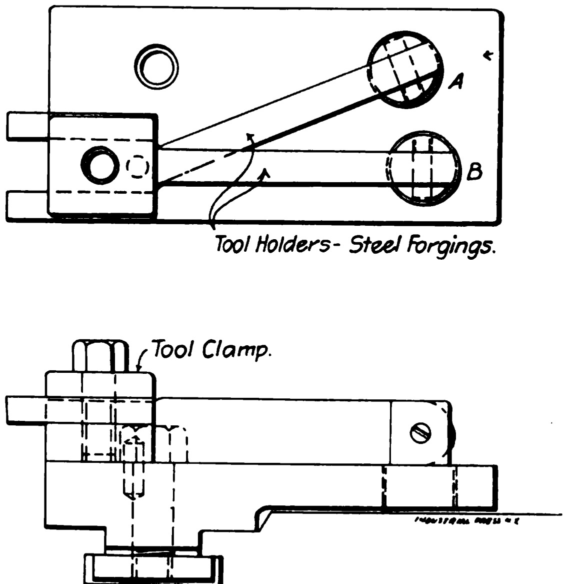
* * *

A bright-looking young fellow with a bundle was about to go to work in a gloomy out-of-date looking shop, filled with a lot of old machinery. After looking around a bit, he decided to go out again and as he turned, the boss stepped up to him and inquired if "he was trying to show his contempt for the shop." "No," the fellow answered, "I was trying to conceal it." H. C. L.

TURRET TOOLS.

USED FOR MACHINING GEAR BLANKS IN THE TURRET LATHE.

The National Machine Tool Co., Cincinnati, O., have recently placed on the market a variable speed countershaft in which the speed changes are obtained through the use of two nests or cones of gears. The gears have to be made in large numbers, and of course are of varying diameters to suit the different steps or speed changes. Those gears that belong to one of the cones of the countershaft have large holes and those that belong to the other cone have smaller holes. In other respects the gears are like ordinary gear wheels having a hub on each side.

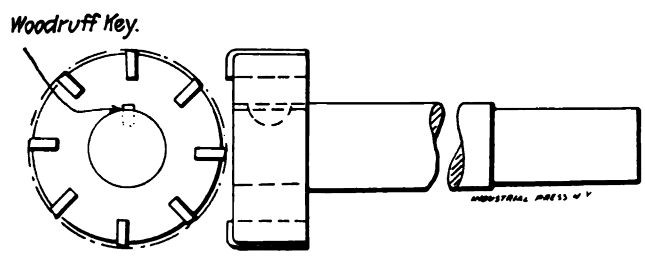


Gear Blank Facing Tool.

Fig. 1.

In order to finish the gear blanks economically a set of turret tools was designed to be used on a turret lathe and the sketches shown herewith illustrate these various tools. Besides the turret tools there is a double tool holder used on the tool block of the lathe and in finishing a gear blank there are six distinct operations, one with the tools on the tool block and five with the turret tools.

The gear is held in the lathe chuck by means of one end of the hub which is gripped on the outside by the jaws of the chuck. The first operation is to rough out the sides of the blank by means of the double holder shown in Fig. 1.

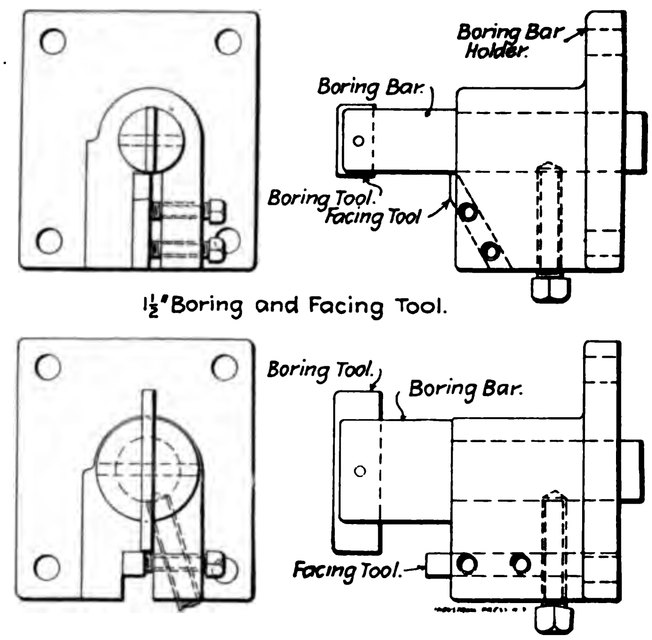


3 7/16" Rose-Bit.

Fig. 4.

It will be seen that there are two holders pivoted at *A* and *B* on a plate designed to clamp to the T-slot of the tool block of the lathe. Either one of the holders may be swung into or out of position as desired and as clearly indicated in the sketch. When either one is swung into position a dowel pin locates it in its proper place. Each of these tool holders carries two cutting tools which, in one case, are spaced far enough apart for roughing out the sides of the gear blank and in the other case for finishing the gear blank to the desired width.

The second operation is to bore the hole in the gear blank. The boring tools are clearly illustrated in Fig. 2. *They are made in two sizes, one for the gears having the small holes and the other for the* gears having the large holes. They are designed to bolt to the face of the turret, and are located concentric with the axis of the lathe spindle by a cylindrical plug which fits the hole in the turret. The boring tools are double-end cutters, fitting in a slot in the end of short boring bars, which latter are held in the tool

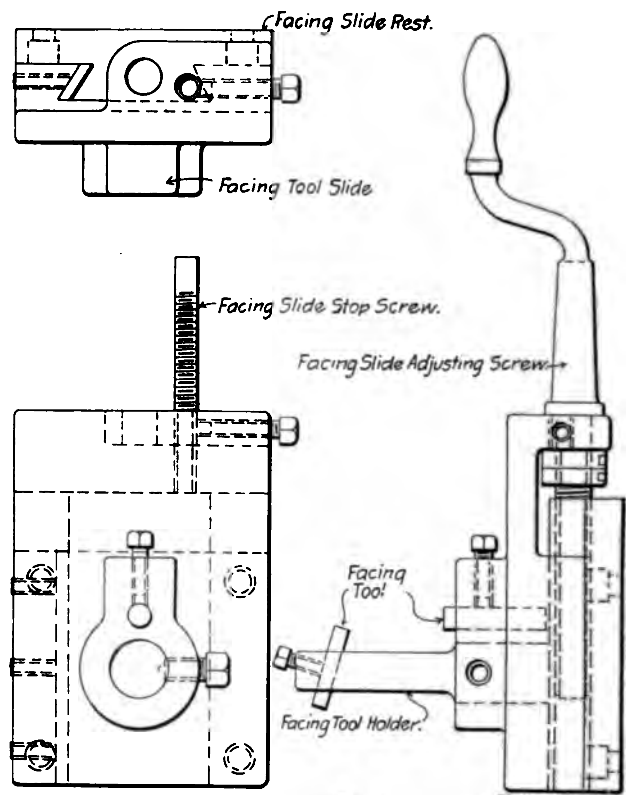


3 7/16" Boring and Facing Tool.

Fig. 2.

holder by means of setscrews. These holders also carry facing tools for facing the outer ends of the hubs, after the boring has been completed.

The third operation is to "single end tool" the hole and to face the rear of the hub and a boring and facing tool shown in Fig. 3 is used which bolts to one of the faces of the turret. It has a slide dovetailed to the main casting, this slide being operated by the handle shown in the side view. The slide



Facing Slide.

Fig. 3.

carries a tool holder long enough to extend through the hub of the gear, so that the cutter carried at the outer end of the holder will be in a position to bore the hole when the turret is fed forward and to face the rear end of the hub when the slide is moved vertically by means of the handle. The upper

and having to sell below cost, of the amount of capital used by the numerous manufacturers, transporting companies and dealers, of the amount of money spent in advertising, and in the employment of traveling salesmen. If the time were the year 1897, when the pound of nails sold for less than two cents, think of the struggles of the several manufacturers to avoid losses, of the reduction of wages, of strikes against such reduction, of the cut-throat competition to sell, which makes profits a vanishing quantity. If the year were 1899, with prices increased over 100 per cent, think of the profits made by those who bought the raw material cheap and sold the manufactured product dear; if the year were 1900, think of the losses sustained by those who were caught with contracts to buy raw material at high prices, and with the sudden decline in demand and in price for the finished article.

"Let us look ahead a few years and see how the situation will be changed. A giant corporation with enormous capital has offices in New York. It owns mines on Lake Superior, railroads to the docks on that lake, steamships carrying the ore to its blast furnaces, steel works, rod mills, and nail works, all located at one place on Lake Erie, steel barges to carry its product through the Erie Canal to its great storehouse on the Hudson River, in New York city, which is part of a vast hardware department store where the product is sold both wholesale and retail. What a saving has been accomplished in human labor, in handling and rehandling, in transportation, in the work of salesmen, in advertising, in cost of carrying stocks of material through every stage from the ore to the finished nail.

This is the industrial revolution that is now impending in the first year of the new century. Shall we complain that its effect will be to destroy the value of hundreds of small iron works and nail mills, that it means less tonnage for railroads, and the discharge of thousands of laboring men, of foremen and superintendents, and of traveling salesmen? The complaint will be a vain one. As well might we complain that the factory system has destroyed the domestic spinning wheel and the household weaving loom, that the locomotive has destroyed the stage coach, that the steel rail has supplanted the iron rail, that the Bessemer converter and the open-hearth has supplanted the puddling furnace. The new industrial and commercial revolution is coming and coming to stay, and in the end will prove as beneficial to the human race as the other revolutions which have preceded it."

SHOP CHARGES.

SYSTEM USED BY THE GRANT TOOL COMPANY.

The following scheme for charging the miscellaneous expenses of a machine shop or manufacturing plant cannot fail to be suggestive to shop accountants and cost keepers, or to those who are organizing a cost system. It is a comparatively easy matter to obtain the direct costs of manufacturing, and to arrange a cost system so that the exact charges for material and the exact time required for the labor upon each piece or a machine being menufactured can be determined at any stage of the process of its production. The incidental and indirect charges, however, are not so easily controlled and are usually both unruly and seemingly excessive in amount, and it is seldom the case that the charges are so made that it can be told just where the money has gone, or at least what department should bear the expense.

The system outlined below, for charging these miscellaneous expenses, is in use at the Grant Tool Co.'s works, Franklin, Pa. Large cards are posted at convenient points in the shops and on them are printed the numbered paragraphs given below, which enumerate the various items of indirect expense connected with the operation of the works. It will be noted that in this enumeration are included both miscellaneous supplies and miscellaneous work. When supplies are purchased or work is done, not directly connected with the production of the machine shop products having order numbers to which time and material are to be charged, the charges are entered under the order number given below. Thus, all the items in the first paragraph are charged to account number five, and in a similar manner the order numbers assigned to the various paragraphs are to be used for work, supplies or material enumerated in the corresponding paragraphs.

LIST OF MISCELLANEOUS SHOP CHARGES.

NO. 5. OFFICE EXPENSE.

Salaries paid for time expended on office work; Blank Books, Stationery for exclusive use of office; Fuel for office, Grates, Oil or other material for lighting; Rubber Stamps, Postage Stamps, Feather Dusters and Brooms; Salary of Janitor and other help in cleaning office; Repairs to Office Furniture; Letter Files; Paper (water closet); Water used exclusively for office; Window Shades in offices.

NO. 6. DRAFTING ROOM EXPENSE.

Salaries paid for work in this department that are not charged direct to any special contracts, Shop Orders or known accounts; all necessary Stationery, Drafting or other material; Oil or other material for lighting; Feather Dusters and Brooms; Paper (water closet); Water used exclusively in this department; Window Shades in this department.

NO. 7. MISCELLANEOUS SHOP EXPENSE.

Brooms for shop use, Brushes, scrub, Paint and Counter, Cans, Oilers other than those used on Account No. 16 (Power and transmitting fixtures) Emery Powder, Paper or Cloth other than that used on patterns, Account No. 12. Material—Charge it to No. 17 where time expended on same is charged to No. 17. Oil—used on Lathes, Planers, Bolt Cutters, and other like shop appliances that are not included in power cost No. 9; Paper for water closet in shop; Pails for shop and forge use; Soda Water used on planers; Sand Paper other than that used on patterns on Account No. 12; Soapine and Soap used for cleaning shop and closets; Time, day and night watchman and doorkeepers; Time attending to heater; Time of Crane Operators; Time Cleaning Shop, Closets, etc.; Time Removing Scrap; Time Removing Cinders from Forges and Furnaces; Time Oiling and Cleaning Shop Power and Hand Tools; Waste used in shop and other than that used on Account No. 9 (Power Cost); Water for Shop Use.

NO. 8. FORGE FUEL.

Coal, Coke or Oil Used in Heating Ovens; Coal, Coke or Oil Used in Forges; Coal or Coke Used in Furnaces; Coal or Coke Used in Blacksmith Forges.

NO. 9. POWER COST.

Cans, Oilers Used on Power Transmitting Fixtures; Coal Used Exclusively for Making Steam; Oil Used on Engines; Oil Used on Pumps, in Stoker, in Line Shafts, in Counter Shafts; Paint or Black Varnish Used on Engine, Paint or Black Varnish Used on Stoker; Paint or Black Varnish Used on Pump, Paint or Black Varnish Used on Boiler Fixtures; Time of Engineer and Time Handling Steam Coal; Time Removing Ashes and Cinders from Boilers; Time Oiling Line and Counter Shafts; Time Extended on Repairs or any other necessary work done to power and transmitting fixtures to keep them in running order; Waste Used by Engineer; Waste Used by Oiler on Line and Counter Shafts; Water Used for Generating Steam.

NO. 10. TEAM ACCOUNT.

Coal used in Warming Barns; Feed, including Hay, Straw, Bran, Corn, etc.; Grease used on Wagons or Harness; Horses; Harness; Stove, including Pipe and Other Fixtures in Barn; Stable Tools, including Shovels, Forks, Wagon Jacks, Brushes, Brooms, Dusters, etc.; Services of Teamster and other help for like purposes; Oil for Lighting, Harness or Lubricating Oils (see stable tools); Water used in barn.

NO. 11. MATERIAL AND MERCHANDISE.

Material of all kinds bought for manufacturing, or partially or wholly manufactured; Freight, Cartage and Switching Charges, unless for some specified account or order.

NO. 12. PATTERNS COST.

Alterations, Bees-Wax, Brushes, Brads, Brass, Glue, Iron, Fillet (leather), Lumber, Nails, Oil, Paint, Putty, Plaster Paris, Rapping Plates, Repairs to Patterns, Shellac, Solder, Screws, Time of Employees in making patterns or any other material for like purposes. The cost of alterations made on patterns for any special contract or order, charge direct to said contract or order.

NO. 13. FURNITURE AND FIXTURES.

GENERAL, PRIVATE AND SHOP OFFICES.

Blue Print Frames, Cases of Drawers for Drawings, Case for Drawing Paper and Tracing Linen, Case for Bills of Material, Work Cards, etc., Clocks in offices and shop, Comptometers, Check Perforator, Cupboards in offices, Chairs, Desks, Drawing Instruments, Fire Screens, Filing Cabinets, Lamps, Printing Presses, Racks for Blue Prints, Safes, stands for letter presses, stools, Surveying Instruments, Typewriters and Stands, Tables, Water Cooler and Filter in office.

NO. 14. ELECTRIC POWER AND LIGHTING PLANT COST.

Generators, Dynamos, Motors, Wires, Lamps, and any other material of a like nature used in erecting this plant or extensions or additions to this plant. Repairs and Renewals to this plant, charge to Account No. 25.

NO. 15. SHOP HEATING PLANT COST.

Fans, Engines, Heating Pipes, Steam Pipes to convey steam to and exhaust from heaters, Valves and other Fittings, Covering for Steam Pipes; Pipes and Fixtures for distributing hot air and any other material of a like nature used in erecting this plant, extensions or additions to this Plant. Repairs to this Plant, charge to Account No. 25.

NO. 16. POWER AND TRANSMITTING FIXTURES.

Air Compressor, Boilers (steam for operating works), Bearings (journal), Blowers (pressure

for forges, etc.), Belt Shifters, Covering for Steam Pipes used in connection with any of the machines included in this account; Exhaust Fans drawing smoke from forges, etc.; Exhaust Fans for Emery Wheels; Engines; Filter (water for engine); Fittings for any fixtures herein; Hangers for Main Line and Sub-Line Shafts; Hoods for Furnaces and Forges; Heater (water for engine); Hot Well, Oilers; all Oilers used on any of the machines or bearings in this Account. Piping—all steam pipes used to convey live or exhaust steam to and from any of the machines in this Account. Piping—all Pipe conveying air to or from forges, furnaces, etc. Pump for Testing Boilers: Pump for Filling Boiler, Stokers (American); Shafting—all Main Line and Sub-Line Shafting, all Countershafting other than that charged with machines. Valves (globe) and other valves in steam pipe charged to this Account, Valves or Windgates in blower or exhaust pipes; Water Tank; Extensions or Additions to Machines, Fixtures or Implements (not including repairs) charge to Account 9.

NO. 17. HAND TOOLS AND APPLIANCES.

Articles enumerated below; Angle Plates, Anvils, Augers of all kinds, Arbors, Bars (crow); Bars (pinch); Bars (pin); Bevels, Bolts in shop used as tools, Blocks and Tackle for shop use; Blocks (flange) Boring Bars, Button Sets, Crabs, Chisels (hand), Chisels-Handled, Chucks, Clamps (Wood, Steel or Iron), Counter Tools, Cutters (blade shape), Cutter Heads, Dies, Drift Pins, Drills, Drill Appliances, Lathe Dogs, Old Men, Oil Tank for Main Shop, Parallels, Punches (hand), Punches (handled), Punches (machine), Files, Forges (portable) for shop use, Fullers, Flatters, Gear Cutters or Collars, Gauges, Hammers, Hydraulic Jacks, Jack Screws, Lamps (oil lighting), Letters and Numerals (steel), Mandrels, Milling Cutters, Punches, Pipe Fitting Tools, Plates (bending), Plates (straightening), Plates (surface), Reamers, Ratchets, Saws (hand, band, cross cut), Sockets for Drills, Sims, Squares (carpenter, try, etc.), Steel Tapes, Slings, Taps, Tools (lathe and planer), Vises, Wheels-Dry and Wet Grinders, Punching Machine (hand), Straight Edges, Sledges, Swages, Sets, Scrapers, Stock and Dies, Tackle and Blocks, Tongs, Tapes (measuring), Wrenches of all kinds.

NO. 18. SHOP POWER TOOLS.

All Machine Tools run by belt or other power; also additions or permanent improvements to any special machine, not including repairs, especially those enumerated below; Boring Mills, Belt Cutters, Benching Rolls, Blacksmith Forges (fixed), Blacksmith Forges (heating): Chucks that are usually furnished with machines and which constitute a part of same; Countershafts and all other appliances furnished with machine; Cutting Off Machine; Cartage paid by us on machines; Drilling Machines: Forges (blacksmith); Forges (heating); freight paid on any machine in this account: Gear Cutters, Grinders (wet and dry), Grind Stones; Hammers (Power); Hammers (Steam); Heating Oven; Hydrostatic Press; Key Seater; Lathes; Milling Machines; Nut Tappers; Planers (straight line or Rotary for Iron or Wood); Pneumatic Drills, Punching Machines, Riveting Machines; Slab Milling Machines; Sawing Machines (Band, Rotary or Jig for iron or wood); Shears, Shears Alligator, Straightening Rolls, Slotters, Spliners, Upsetters. Repairs to Shop Power Tools charge to Account No. 47.

NO. 19. BELTS.

Belts bought after June 1, 1901, that are to be used on shop power tools, power and transmitting fixtures, electric power and light plant. Those for use on hand tools and appliances charge to Account No. 17.

NO. 21. INVENTORY EXPENSE.

Time expended in arranging stock or listing same: Books and Stationery used; all other necessary expenses incurred in completing same.

NO. 22. REAL ESTATE.

Real estate at cost, Railroad Tracks on same, Special Assessments for improvements; Sewers in street and on property; Sidewalks; Paving and other expenditures of like nature.

NO. 23. TRAVELING EXPENSES.

All money expended in traveling on the Company's business when not chargeable to some designated account, order or contract.

NO. 24. ACCIDENT EXPENSE.

Ambulance Service, Nurses' Service, Doctors' Service, Hospital Care, Medicine required and all other expense incurred on account of accidents to employees while at work for us.

NO. 25. BUILDING REPAIRS.

Material and Labor required to keep buildings in good condition. If the repairs in the opinion of the Superintendent will cost $5.00 or over, have a special shop order issued for the work. Note: (This does not include additions or permanent improvements.)

NO. 26. LITIGATION.

All expenses of litigation arising from suits brought by the Company or against it unless on account of accident to employees.

NO. 27. OFFICE BUILDING COST.

All additions and permanent improvements to same. Note: (This does not include repairs)—charge to Account No. 25.

NO. 28. BARN BUILDING COST.

All additions or permanent improvements to same. Note: (This does not include repairs)—charge to Account No. 25.

NO. 29. DINING ROOM EXPENSE.

Wages paid Cook and other Labor; Coal, Wood, Coke or Gas; Water Rent; all other expenses, not including Food Supplies.

NO. 30. DINING ROOM FOOD SUPPLIES.

All Food Supplies for Dining Room.

NO. 31. OFFICE HEATING PLANT.

Material and Labor expended in extending or enlarging plant. Note: (This does not include repairs.) Repairs to be charged one-half to Account No. 5, and one-half to Account No. 6.

NO. 32. MATERIAL MANUFACTURED.

All Material manufactured on shop orders which is not sold. Note: (Material must *not* be made on this Account.)

NO. 33. BUILDING A. (OFFICE BUILDING.)

All Additions and Permanent Improvements to same. Note: (This does not include repairs.) Repairs charge to Account No. 25.

NO. 34. BUILDING B. (MACHINE SHOP.)

All Additions and Permanent Improvements. Note: (This does not include repairs.) Repairs charge to Account No. 25. (Note.—There are similar paragraphs referring to the other buildings.)

NO. 40. JIGS, FORMERS AND TEMPLATES.

Material and Labor expended in making any of the above-named articles. Note: (None of the above-named articles must be made until instructions for so doing have been received from Superintendent of shop.) When any of the above articles are required, the Superintendent of shop will decide as to the cost of the article called for. If it will cost $2.00 or over, it must be made on a shop order, issued for that purpose, which will be drawn when requested by the Superintendent. Each individual Jig, Former and Template must have its individual number stamped or otherwise put upon it. A book must be kept giving a list of all articles in this account. The cost of all articles made for this account must be reported to the general office as soon as completed.

NO. 41. CRANES, TROLLEYS AND PULLEY BLOCKS.

All cranes used at works; all trolleys used at works; all Pulley Blocks used at works.

NO. 42. SHOP EQUIPMENT.

Barrows, Benches in center of shop, Bins in shop for nuts, Bins in stock room; Cars, Push around Shop; Cars, push on railroad track; Cupboards in shop; Drawing Boards in pattern shop; Galvanized Pans; Horses for bridge and other material; Horses in yard; Horses in shop on which machines are put together; Ladders; Layout Tables; Racks for storing tools; Racks for storing material in shop and yard; Roller Tables; Roller Stands; Scales (tracks), Scales (wagon), Scales (shop and yard); Shanties and Sheds in yard; Stove and Pipes used in Shanties; Steaming Boxes for wood bending; Tool Stands; Trucks (timber); Tracks (temporary, consisting of rails and timber); Trucks (hand), Trucks (push around shop); Water Cooler in shops.

NO. 43. MAINTENANCE OF SHOP OFFICE.

Books, Blanks and Stationery used in same: Towels used in same; Washing of Towels for same; Water Rent; Soap and all other materials required for this purpose; Wages of Clerks in same; all other Material and Labor used for this purpose; Paper (water closet).

NO. 44. SUPERINTENDENCE IN SHOPS.

Salary of Superintendent; Salary of Assistant Superintendent; Salary of Foreman of Machine Shop; Salary of Foreman of Blacksmith Shop; Salary of Foreman of Ball Shop; Salary of Foreman of Pattern Shop. Wages of Sub-Foremen when unable to charge direct to designated account, order or contract.

NO. 45. MAINTENANCE OF STORE ROOM.

Books, Blanks and Stationery required, Towels used in store room; Washing Towels; Water Rent; Soap and all other materials used for this purpose; Labor of Clerks and Helpers in same; Labor in delivery of material when unable to charge to account or order on which time is expended.

NO. 46. MAINTENANCE OF TOOL ROOM.

Time of Boys delivering and returning tools; Time of Foreman of Tool Room; Time of Machinist in Tool Room; Time of Helpers in Tool Room—except, when working on shop order charge to the order; When making new tools, charge to Account No. 17. When repairing tools, charge to Account No. 47.

NO. 47. REPAIR TO HAND TOOLS, SHOP POWER TOOLS, SHOP HEATING PLANT, SHOP EQUIPMENT AND CRANES.

Handles (wood for all purposes); Material used in repairs only; Labor expended in repairs only.

NO. 48. OPERATING ELECTRIC POWER AND LIGHTING PLANT.

Labor required in Engine Room, Running Engine, Air Compressor and Generator; Labor Looking After lines and Repairing Same; Oil, Waste and other Material required in running machines in engine room; Material required in looking after and repairing lines; Lamps, Globes and Carbons for Renewals.

NO. 49. FOUNDATIONS FOR SHOP POWER TOOLS, POWER TRANSMITTING AND FIXTURES.

Labor in excavating for foundations, Material used in foundations, Labor filling around foundations, labor in relaying floor where same had to be removed to build foundation.

Placing Shop Power Tools and Power. Transmitting Fixtures Permanently, ready for Power Connection.

NO. 50. PLACING SHOP POWER TOOLS AND POWER TRANSMITTING FIXTURES PERMANENTLY, READY FOR POWER CONNECTION.

Labor and Other Expenses in unloading and moving same to position. Material and Labor used in fastening same to position; Material and Labor used in erecting countershaft ready for belt connection; labor making belt connections.

NO. 51. CORRECTING ERRORS ARISING IN MACHINE SHOP.

Material and Labor expended in replacing which (for any cause arising in this department) has been rendered unfit for the use intended. Before ordering any material or doing any work to replace defective material, the matter must be referred to the Superintendent of shop who will instruct whether the work will be replaced on the parent order or on a separate order drawn for that purpose. If material to be replaced will cost $2.00 or over the Superintendent must see that the replacing is done on a separate shop order which will be issued for that purpose at his request.

NO. 52. CORRECTING ERRORS ARISING IN FITTING DEPARTMENT.

(See Account No. 51.)

Similar references to errors arising in the other departments.

NO. 56. REPLACING DEFECTIVE MATERIAL.

Charge to this Account.

Material and Labor required to replace material found defective after work has been done on it. In replacing follow instructions given under Account No. 51.

NO. 57. CORRECTING ERRORS ARISING IN DRAFTING ROOM.

Charge to this Account.

(See Account No. 51.)

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

JANUARY, 1902.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

1901.		1901.		1901.		1901.	
Feb.....	26,500	May.. ..	26.500	Aug.... .	29,492	Nov.....	31,743
Mar....	30,000	June....	28,000	Sept....	28,105	Dec.....	29,237
April...	26,000	July.....	28,964	Oct......	28,345	Jan. '02.	30,021

No other paper in this field prints its circulation figures.

THE BONUS SYSTEM.

In any attempt at cost reduction by means of some one of the various schemes for payment of wages, other than paying by the day, such as piece work, premium plan, piece rate system, etc., the object sought is to induce the workman to produce more work than he would if left to his own resources and inclination. Some systems *force* a man to work harder, and perhaps very much harder, in order to earn a fair day's pay; and if he does not work very much harder his reduced wages amount to a forfeiture or penalty imposed upon him in consequence.

If strict justice, only, were required in this world, there could be but little fault found with such a system, which compensates a man for what he actually does—no more, no less. Experience shows pretty conclusively, however, that it is more effective to lead a man than it is to drive him, and the more agreeable the means taken to lead him, the better will be the results. For this reason we believe it is better to guarantee a man a fair daily wage, and then to pay him a premium in some form or other, if he does well, than to pay him strictly according to his production, which, as explained, amounts virtually to a forfeiture in some cases. While it may be argued that if a man earns less he should be paid less, it is just as fair to fix his day rate according to his ability to turn out work and then to give him the opportunity to earn more if he can.

Last month we explained how the piece work system, pure and simple, might be so modified as to be conducted upon this plan, and that when so modified it would not be unlike some of the more modern methods of wage payment. In another column of this number is a brief extract of a paper by H. L. Gantt, presented before the American Society of Mechanical Engineers, upon a bonus system for compensating labor. This system is in use at the works of the Bethlehem Steel Co. and is based on the plan of paying a man a regular day rate and a bonus in addition, if he earns it. Each workman is given a card on which are carefully prepared directions for performing all the operations on the the piece that he is to work upon and the estimated time for completing each operation is also written on the card. This plan is carried to such an extent that even the necessary time for changing a piece end for end, for adjusting the change gears of a lathe, etc., is accounted for and the particular kinds of tools or steel for tools, the feeds and speeds, etc., are specified. With this information given him the workman goes to work, and if he completes the piece in the time specified he receives a bonus; otherwise he obtains only his regular wages.

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PLANNING A MACHINIST'S WORK.

The custom of making out a complete list of operations to be followed by a machinist in producing a piece of work is coming more and more to be adopted, and is one of the developments incidental to modern methods. While the custom may be resented by some, who will look upon it as only another step in the direction of making a machine out of what was a machinist, or of placing a man in the position where he is "paid to work but not to think," we believe that such a result is far from what is actually attained. Machine shop methods have been developed to such an extent and in such a multitude of directions, that the machinist who does the work, or anybody else for that matter, cannot tell offhand just how it is best to machine a piece, and what speeds and feeds, or what tools, even, will be the most effective. Yet he or his foreman is frequently depended upon to turn out the work at small cost in a haphazard way, without having time to actually study the conditions. So it is that the plan is growing in favor of having a practical man or men, as the case may be, to gather data upon the capacities of the various machine tools; of the capabilities of different brands of steel; of the time required to handle work, and of the operations that appear to be best adapted to each piece of work and the order in which they should be performed. Such men should themselves be skilled machinists who can go to a tool and demonstrate, if necessary, that the work can be done as they direct, and in the time set, should their figures be doubted.

We have in mind a firm who took a large contract for government work with which they were very successful. Another firm took a contract for the same kind of work and failed, and were obliged to turn over their contract to the first firm. The reason why one firm was successful and the other was not was because one planned out every operation and every jig beforehand and the other did not.

If the plan outlined above should come into more or less general use, how will it affect the machinist? The machinist has always been called a thinking man, but instead of converting him into a dummy, this should lead him to rack his brain more than ever. It is like placing him at school. He will be directed how to do work according to a carefully thought out plan, and he will naturally question why this or that way was adopted and will finally begin to plan out ways for himself. He will become more skilful and will himself devise improved methods, which, under a system like that at Bethlehem, will be rewarded in cash. We see no reason to fear any bad results from the system, so far as the machinist is concerned, because it will afford every operator a chance to learn more and to become a more expert workman, which always has reacted and will always react to the direct benefit of the workman, financially and otherwise.

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NOTES AND COMMENT.

But little has been heard of the new Edison storage battery since the announcement of its invention and the explanation of its principle of construction last May. According to the *Electrical World and Engineer*, however, the battery will probably be on the market and for sale by nex[illegible] spring. The Edison Storage Battery Co. was organized wit[illegible] a capital of $1,000,000 last June, and since then there hav[illegible] been active preparations for the manufacture of the ne[illegible] battery. A new factory is being equipped at Glen Ridg[illegible] N. J., and it is expected that its initial output will be abou[illegible] 100 horse power daily. Two other plants have been erecte[illegible] for the enterprise at other localities, one for preparing iro[illegible] oxide and graphite and the other as a distillation plant. I[illegible] the meantime Mr. Edison and his assistants are at work [illegible] improve the battery in every possible way. While the batte[illegible] is announced to weigh only about one-third as much as t[illegible] older types of like capacity, it is not by any means what m[illegible]

be called light weight. A single cell of the battery exhibited at Buffalo, 12 inches high, 2 inches thick and 5 inches wide, weighed 7½ pounds, and had a capacity of about .16 horse power per hour, or the assembled battery would weigh about 46 pounds per horse power hour. Assuming a small automobile to require a constant power of two horse power, a small allowance, the battery would have to weigh about 500 pounds to have an endurance of five hours, and as a matter of fact a 750-pound battery would not have any too large capacity.

The power plant in the course of construction on the Susquehanna River, about 16 miles from Harrisburg, will rival any plant of the kind in the country aside from the Niagara Falls plants. The operation consists in the development of an immense electrical power plant which will utilize nearly all of the water in the river by diverting its course at a point called the Falls just above where the plant will be located. There will be built a power house 478 feet long and 51 feet wide, in which there will be 40 turbine water wheels of 600 horse power each, operating twenty 750 kilowatt generators, together with two turbines of 250 horse power each to drive machines for excitation. A contract for the generators has been awarded to the Stanley Electric Mfg. Co., and for the turbines to Robert Poole, Sons & Co., of Baltimore.

It is a peculiar circumstance that there is no unit in common use for measuring large volumes of liquids, other than the gallon, which is equal to only 231 cubic inches. In measuring massive weights we use tons; in linear measure we use the yard, rod or mile for long distances; and in square measures the square yard, square mile, or acre, equal to 4,840 square yards, are all available. In cubic measures, also, large units are used when referring to solids, as for example, bushels, equal to 2,150.42 cubic inches, are employed for grain and cubic yards for measuring earthwork. When it comes to liquids, however, we seldom use a measure larger than the gallon. We never hear of a reservoir holding so many barrels, and cubic feet, even, are seldom employed in this connection. We speak of the reservoir or tank as holding 10,000,000 gallons, or 1,000 gallons, as the case may be. It is like measuring the distance from New York to Philadelphia, a distance of 90 miles, in inches. In stating the distance between the two cities we should then say that it was 5,702,400 inches, which gives one small conception of the actual distance.

GATHMANN GUN EXPERIMENTS.

The tests at Sandy Hook proving ground during the past month with the Gathmann gun and a modern high-power gun firing armor-piercing projectiles were perhaps the most important tests of the kind that have ever been conducted. When armor plate was first made by the Harvey and Krupp processes it was found to be impenetrable by the projectiles then in use, and the charges carried by the projectiles exploded upon impact against the surface of the plate with but little damage to the plate. The Gathmann gun was built to try the effect of exploding still heavier charges against the surface of a plate. The shell carried 500 pounds of gun cotton; and while the gun was built upon the plan of modern steel rifles and its projectiles struck a tremendous blow, it was not designed for armor piercing. The result of the explosion of the shells at the proving ground was to move the plate and backing used as a target several feet from its foundations, and a similar charge fired against a battleship would undoubtedly rack the structure. The actual damage done to the plate, however, was slight.

The high-power gun was tested under as nearly parallel conditions as possible, but the shot passed entirely through the thick armor plate, the small charge carried exploding while passing through and wrecking the plate. The tests seem to conclusively demonstrate that the effectiveness of ordnance has been increased to a remarkable extent, and that inasmuch as a projectile can be made to pierce a plate, the destructive qualities of its charge must necessarily be much greater than can be possible with a much larger charge exploded against the plate.

PIPE COVERING TESTS.

Results of an extensive series of tests by Geo. H. Barrus, the consulting engineer, to determine the efficiency of pipe coverings, have been reported during the past month. These tests were made at the new power plant of the Manhattan Elevated Railway, New York City. The coverings tested were bought in the open market, and the results show that the various kinds of asbestos air-cell covering, which is made in several forms, is the most efficient under the conditions of the tests. The test plant was divided into two sections, one carrying 80 pounds pressure and the other 150 pounds. The high-pressure section included five 2-inch pipes connected to a common header, each 100 feet long, and two 10-inch pipes, each 35 feet long. The 80-pounds pressure section consisted of five 2-inch pipes, each 100 feet long. Precautions were taken to secure dry steam, and the quantity of water collected from the various pipes showed the efficiency of the covering used on those pipes. It was also found that the amount of evaporation was not dependent upon the velocity of flow through the pipes, and so most of the tests were made with pipes having dead ends, the steam flow being only sufficient to take care of the condensation. The coverings ranking first and second, respectively, at 80-pounds pressure, were Johns' Asbestocel and the New York Air Cell. With the 2-inch pipe, 150-pounds pressure, Johns' Asbesto-Sponge Hair Felt, three-ply, stood first, and the two-ply of the same material, second; with the 10-inch pipe, 150 pounds pressure, Johns' Asbesto-Sponge Felted, first, and K. & M. Magnesia (85 per cent Carb. of Mag), second. Other coverings selected for the test, and which did well, were Carey's Moulded, Gast's Ambler Air Cell, Asbestos Fire Felt (Navy Brand) and Watson's Imperial.

MORE DEVELOPMENTS IN RAPID TRANSIT.

MACHINERY has already explained the plan of the Pennsylvania Railroad, first announced in the *Outlook*, to connect Manhattan Island with the New Jersey shore by a mammoth railroad bridge, which was to be used in common by the several railroads having terminals in New Jersey for New York City. It is now definitely announced that this plan is not to be carried through, but that a tunnel will be built under the Hudson, or North River, for the exclusive use of the Pennsylvania Railroad, and that the tunnel will also be extended to Long Island to connect with the Long Island Railroad, recently leased by the Pennsylvania Railroad. It is estimated that the cost of the tunnel will not exceed $20,000,000, which is very much less than the probable cost of the suspension bridge formerly proposed, and it will rank as one of the great engineering achievements, not only because of the enormity of the undertaking, but because of the potent influence that it will have upon travel and the suburban life of people doing business in New York City. It will enable through trains to be run from New England points to southern and western sections of the country by means of a bridge connection between Long Island and the main land, and will facilitate reaching large suburban sections in New Jersey and Long Island.

The new railroad station in New York will have tracks and platforms underground, and from there the tunnel will pass under the North River to New Jersey in one direction, and Long Island in the other direction. The tunnel will consist of from two to four steel tubes about 18 feet in diameter, braced and stiffened to sustain the load of the trains and track, and it will rest on piling foundation beneath the river bottom. Work is to begin at once, or as soon as the necessary permits are obtained, and it is expected that the project will be completed in the early part of 1895. It is quite possible that this commendable and important move on the part of the Pennsylvania Railroad will mean even more to New York City than the rapid transit tunnel now under construction.

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The *Aluminum World* says that the best lubricant to use on aluminum when turning it in a lathe, is either petroleum or water and in the press, when it is being drawn or stamped, vaseline.

ANNUAL MEETING OF THE A. S. M. E.

NOTES ON THE BUSINESS SESSIONS AND ABSTRACTS FROM SEVERAL PAPERS.

The annual meeting of the American Society of Mechanical Engineers was held at the society's house, New York, December 3 to 6, inclusive. The first session opened with an address by the retiring president, Mr. S. T. Wellman, Cleveland, who took as his subject "The Early History of Open Hearth Steel Manufacture in the United States." This address was in the nature of a recital of the experiences and observations of its author, in accordance with what has come to be the usual custom of the presidents of the society in preparing their addresses.

At the first business session was the election of officers as follows: President, Edwin Reynolds, Milwaukee; treasurer, William H. Wiley, New York; vice-presidents, Wilfred Lewis, Philadelphia; M. E. Cooley, Ann Harbor; M. P. Higgins, Worcester; Managers, R. S. Moore, San Francisco; H. A. Gillis, Richmond; C. H. Corbett, Brooklyn.

The motion to increase the dues of the members of the American Society of Mechanical Engineers was defeated at this session, as was quite generally expected. The vote stood 647 to 191, many members who were unable to be present, voting by proxy. The effort to increase the dues on the part of the secretary and certain members of the council naturally led to inquiries as to why this should be necessary, and arguments pro and con. There was a general overhauling and criticism of the management and affairs of the society, and the discussion was extended and at times animated enough to be interesting. The fact, as announced, that the society has been contracting an annual debt for some time without the knowledge of the members at large, or even of all the members of the council, has led to the conviction that there is plenty of opportunity to improve the system of management, and that these improvements should be made before the society attempts to raise more money by increase of dues or otherwise. The admitted ignorance of the affairs of the society by some of the members of the council, at least, appears to us inexcusable.

A committee is to be appointed to investigate the subject more fully, and to consider whether it is practicable to carry on the work of the society in an efficient manner with the present dues. If necessary the books will be audited, and when the report is finally made the members of the society will be in a position to take further action intelligently, if such action is called for.

The next (spring) meeting of the society is to be held at Boston, Mass.

Edwin Reynolds.

The new president, Mr. Edwin Reynolds, is one of the most distinguished engineers who has honored the society in this capacity. Mr. Reynolds was a farmer's boy and learned the machinist's trade in Connecticut. He afterwards held several positions where he was engaged in the construction of machinery, but in this earlier work he became best known after he entered the employ of Geo. H. Corliss, Providence, R. I., then the most prominent engine builder in the country, and of whose works he finally became general superintendent. He later went West to take charge of the E. P. Allis Co.'s works, after the concern had failed, and he has brought this company up to their present commanding position through his own energy and ability. The first move made in the new position was to put the concern on a paying basis, which he did by building the Reynolds-Corliss engine. The first machines were built with the beds of such design that they could be used either for a left or right-hand engine, and in other ways the design was made to fit the tools of the shop and to accommodate the pocketbooks of the builders. At one time a certain new machine tool was needed for the works, and Mr. Reynolds was obliged to give his own note for it. This illustrates the difficulties under which the firm labored.

Mr. Reynolds' work has always been characterized by originality, and he has never hesitated to adopt what appeared to be radical methods, if they appealed to his sound judgment. At the Corliss works he at one time took an order for a 20 by 42 engine for the Trenton Iron works, which, according to specifications, must run at 160 revolutions a minute. This required special valve gear and large ports, and Corliss refused to have anything to do with the order, saying that Reynolds must take the entire responsibility, which he did, and the engine ran satisfactorily. This was a noteworthy achievement for that time.

At the Allis works he has not only engaged in engine building, but in general engineering practice. One of his improvements was the substitution of solid for flexible foundations under steam stamps, the base for each stamp being constructed of 40 tons of cast iron in place of a springy structure, with the result of increasing the output 50 per cent. Another original achievement was the installation of a screw pumping system for Milwaukee, used in connection with the sewage system. The pumps held a form of propeller wheels which forced the liquid ahead in the pipes, the action of the propellers on the liquid being made more effective by suitably arranged vanes, which caught the liquid forced outward by centrifugal force and guided it in a forward direction. His latest and most important work is in connection with the 8,000 horse power engines for the Manhattan Elevated road of New York. These units are so large as to make the usual construction an exceedingly difficult feat, on account of the mammoth flywheels that would be required. Reynolds' design is for a double compound engine having horizontal high-pressure cylinders and low-pressure vertical cylinders, the high-pressure and low-pressure cylinders on each side working on the same crank. This construction gives so uniform a turning moment that no flywheel is required other than the armature of the generator.

The Fulton Memorial.

Among the interesting events of this series of meetings was the dedication of a monument to Robert Fulton, the noted engineer and pioneer in steam navigation. Fulton was buried in Trinity Churchyard, New York, but his grave has never been marked by a suitable monument. During the past two years the society has raised a suitable sum for such a monument, which has recently been erected in the churchyard. The exercises were conducted by Rev. Robert Fulton Crary, of Poughkeepsie, N. Y., a grandson of the inventor. Just before the commencement of the services the society listened to addresses in Trinity Building, adjoining the church, by Rear-Admiral Melville and Prof. R. H. Thurston. Mr. Melville sketched the life and history of Robert Fulton, while Professor Thurston spoke in praise of Fulton as a man. Charles H. Haswell, first Chief Engineer of the Navy, who saw Fulton's first steamboat, the "Clermont," and assisted in the production of his second warship, the "Fulton II.," was present at the exercises.

THE PAPERS.

In the last number of MACHINERY a list was published of the technical papers to be presented at this meeting, and in this number are brief extracts from those that will be of the greatest interest or value to our readers. In addition to the regular papers a final report was made by the committee appointed some time ago to formulate standard proportions for engines and dynamos when used in direct-connected units, and the preliminary report was submitted of the committee previously appointed to formulate standard specifications for engine testing.

BONUS SYSTEM.

The paper which drew out the most comment at the annual meeting of the American Society of Mechanical Engineers was the one by H. L. Gantt, South Bethlehem, Pa., upon "A Bonus System of Rewarding Labor." This system is an attempt at harmonizing the interests of the employer and employe, and while it affords substantial justice to the employe, requires that he shall always conform to the best interests of his employer.

A card is made out, showing in detail the best method (so far as our present knowledge goes on the subject) of performing each of the elementary operations on any piece of work, specifying the tools to be used, and setting the time needed for each of these operations as determined by experiments.

ım of these times is the total time needed to complete ›ce of work. If the man follows his instructions, and ›lishes all the work laid out for him, as constituting ›per task for the day, he is paid a definite bonus in ›n to the day rate which he already gets. If, however, end of the day, he has failed to accomplish all of the aid out, he does not get his bonus, but simply his day As the time for each detail operation is stated on the :tion card, the workman can see continually whether arning his bonus or not, and if he finds any operation cannot be done in the time set, he must at once report ıis foreman. If, on careful investigation by the man ; out the card, the workman's statement is found to ·ect—that a portion of the task can not be done in the :ated on the card—a new instruction card is made out, ıing the proper method of working, and allowing the time. The foremen also receive, in addition to their ıges, compensation proportional to the number of their ho earn a bonus, and an extra compensation if all of ıen earn their bonuses.

hese cards are made out by a skilful·man, with the ı at hand, they invariably prescribe a better method .ng the work than the ordinary workman or foreman ievise on the spur of the moment. As all the appli- ınd instructions necessary for doing the work are fur- and a fixed premium or bonus is allowed the work- ı addition to his regular rate if the work is done satis- ly in the time set, it will be seen at once that this l is really a system of education, with prizes for those ırn, and the results already obtained bear out this idea :ation most fully, for the author states that under it ıve learned more in a few months than they did before ·s.

FLYWHEEL TESTS.

several years tests have been conducted at the Case of Applied Science, Cleveland, Ohio, to find the rela- rength of flywheels of different designs and propor- .nd the results of these form the best data we have upon ength of such wheels at the present time. The tests ıade upon small, model wheels, 15 inches to 2 feet in er, run at enormously high speeds by means of a steam , until they finally burst. Apparatus was provided for ng the speed at the time of bursting. At the annual ; of the American Society of Mechanical Engineers in ·rof. C. H. Benjamin gave results of the tests made :hat time and drew the following conclusions:

'lywheels with solid rims, of the proportions usual engine builders, and having the usual number of arms, sufficient factor of safety at a rim speed of 100 feet :ond, if the iron is of good quality and there are no cooling strains. In such wheels the bending due to ıgal force is slight and may be safely disregarded.

:im joints midway between the arms are a serious de- ıd reduce the factor of safety very materially. Such ıre as serious mistakes as would be a joint in the mid- ı girder under a heavy load.

oints made in the ordinary manner, with internal and bolts, are probably the worst that could be de- or the purpose. Under the most favorable conditions ave only about one-fourth the strength of the solid d are particularly weak against bending. In several of this character on large flywheels calculation shows gth less than one-fifth that of a solid rim.

'he type of joint having the rim held together with s probably the best that could be devised for narrow l wheels not intended to carry belts, and possesses, when y designed, a strength about two-thirds that of the ım.

he last meeting of the society, Prof. Benjamin again ›me data, deduced from experiments conducted since Wheels with solid rims were again tested, to afford a :d for comparison by which wheels with jointed rims .ous designs could be judged. These burst at a rim of 395 feet per second, corresponding to a centrifugal of about 15,600 pounds per square inch.

wheels were tested with joints and bolts inside the rim, after the familiar design ordinarily employed for band wheels, but with the joints located at points one-fourth of the distance from one arm to the next, these being the points of least bending moment, and, consequently, the points at which the deflection due to centrifugal force would be expected to have the least effect. The tests, however, did not bear out this conclusion. The wheels burst at a rim speed of 194 feet per second, corresponding to a centrifugal tension of about 3,750 pounds per square inch. These wheels, therefore, were only about one-quarter as strong as the wheels with solid rims, and burst at practically the same speed as wheels in the previous series of tests in which the rim joints were midway between the arms. This is doubtless due to the fact that the heavy mass of the flanges and bolts locates the bending moment near them. In these wheels the combined tensile strength of the bolts in the flange joints was slightly less than one-third the strength of the rim, which is about the maximum ratio possible with this style of joint.

Another type of wheel with deep rim, fastened together at the joints midway between the arms by links shrunk into recesses, after the manner of flywheels for massive engines, gave much superior results. This wheel burst at a speed of 256 feet per second indicating a centrifugal tension of about 6,600 pounds per square inch.

Tests were made on a band wheel having joints inside the rim, midway between the arms, and in all respects like others of this design previously tested, except that tie rods were used to connect the joints with the hub. It burst at a speed of 225 feet per second, showing an increase of strength of 30 to 40 per cent over similar wheels without the tie rods. Several wheels of special design, not in common use, were also tested, the one giving the greatest strength being an English wheel, with solid rim of I-section, made of high-grade cast iron and with the rim tied to the hub by steel wire spokes. These spokes were adjusted to have a uniform tension by "tuning," and the wheel gave way at a rim speed of 424 feet per second, which is slightly higher than the speed of rupture of the solid rim wheels with ordinary style of spokes.

COMPRESSION TESTS ON COIL SPRINGS.

A second paper by Prof. Benjamin summarizes the results of tests made at the Case School upon a large number of springs. Over 1,600 were tested. The object of the tests was to find the coefficient of torsional elasticity and the safe stress for springs made of different sizes of bars and having different ratios of diameter of spring to diameter of bar. The formulas given for the safe load for a spring of given proportions and for the deflection of a spring, due to a given load, are:

$$P = \frac{S d^3}{2.55 D} \text{ and } x = \frac{L D S}{G d}$$

where P = load in pounds; S = torsional stress in pounds per square inch; G = coefficient of torsional elasticity; D = mean diameter of spring in inches; d = diameter of bar in inches; H = height of spring in inches; L = length of bar in inches; and x = deflection in inches with load P.

The value for G, the coefficient of torsional elasticity, is given in most hand-books as 12,000,000. In these tests the values ranged higher than this, the highest value being 18,-900,000 and the lowest 12,500,000. This variation is due both to variation in temper and to slight differences in the chemical constituents of the steel. The average of all the tests is found to be 14,700,000, which may be written 14,500,000 for convenience. The size of bar has much to do with the safe value of S, the torsional stress in pounds per square inch, since it is not possible to work a large bar so that it will be as homogeneous as a small bar. Springs of small diameter may be safely subjected to a higher stress than those of large diameter, but the proportions should not be carried to an extreme, and a spring to have good service should have a mean diameter not less than three times the diameter of the bar.

For a good grade of steel the following values of S have been found safe under ordinary conditions of service, the value of G being taken as 14,500,000. The ratio of the mean diameter of spring to the diameter of bar is expressed by R in the following:

For bars below $\frac{5}{8}$ inch diameter:

$R = 3 \qquad S = 112{,}000$

$R = 8 \qquad S = 85{,}000$

For bars 7-16 to $\frac{3}{4}$ inch in diameter:

$R = 3 \qquad S = 110{,}000$

$R = 8 \qquad S = 80{,}000$

For bars from 13-16 to $1\frac{1}{4}$ inches in diameter:

$R = 3 \qquad S = 105{,}000$

$R = 8 \qquad S = 75{,}000$

For bars over $1\frac{1}{4}$ inches in diameter a stress of more than 100,000 should not be used. Where a spring is subjected to sudden shocks a smaller value of S is necessary.

The springs referred to in this paper are all compression springs with open coils. Experience has shown that in close coil or extension springs the value of G is the same, but that the safe value of S is only about two-thirds that for a compression spring of the same dimensions.

ROPE TRANSMISSION.

C. W. Hunt presented a few notes on working loads for manila rope which are summarized in the tables given herewith. This information is from his own and others' experience. The weakening effect of knots as shown in the second table is determined from tests made at the Massachusetts Institute of Technology, Boston. In the first table the work required of the rope is, for convenience, divided into three classes: "rapid," "medium," and "slow," these terms being used in the following sense:

"Slow"—Derrick, crane, and quarry work; speed from 50 to 100 feet per minute.

"Medium"—Wharf and cargo, hoisting 150 to 300 feet per minute.

Working Load for Manila Rope.

A	B	C	D	E	F	G	H
Diameter of Rope, Inches.	Ultimate Strength. Pounds.	Working Load in Pounds.			Minimum Diameter of Sheaves in Inches.		
		Rapid	Medium.	Slow.	Rapid.	Medium	Slow.
1	7,100	200	400	1,000	40	12	8
$1\frac{1}{8}$	9.000	250	500	1.250	45	13	9
$1\frac{1}{4}$	11,000	300	600	1,500	50	14	10
$1\frac{3}{8}$	13.400	380	750	1.900	55	15	11
$1\frac{1}{2}$	15,800	450	900	2,200	60	16	12
$1\frac{5}{8}$	18,800	530	1,100	2.600	65	17	13
$1\frac{3}{4}$	21,800	620	1,250	3,000	70	18	14

The Efficiency of Knots in a Percentage of the Full Strength of the Rope, and the Factor of Safety when Used with Stresses, as per Column B, in Table above.

I	J	K	L	M	N	O	P
	Eye-splice over an Iron Thimble.	Short Splice in the Rope.	Timber Hitch, Round Turn, and Half-hitch	Bowline Slip Knot, Clove Hitch.	Square Knot, Weavers' Knot, Sheet Bend	Flemish Loop, Overhand Knot.	Rope Dry. Average of Four Tests from the Same Coil as the Knots.
The Efficiency of the knot.......	90	80	65	60	50	45	100
Factor of safety..	6 3	5.6	4 5	4.2	3.5	3.1	7

"Rapid"—400 to 800 feet per minute.

The diameter of the rope in column A is obtained by dividing the girth by 3.1416. This method gives for a three-strand rope nine-tenths, and for a four-strand ninety-three hundredths of the diameter of a circumscribed circle. The girth method corresponds closely to the circular diameter of the rope when under stress, and is the most convenient method to use.

* * *

A writer in the *American Blacksmith* calls attention to the old trick of softening hard cast iron so that it may be drilled. Heat the iron to a low red and place on the spot where the hole is wanted a piece of brimstone the size of a bean, and let the iron cool off slowly. Use no oil in drilling. If any lubricant is used let it be water or turpentine.

HOW THE VELOCITY OF PROJECTILES IS MEASURED.

Time was when the testing of a gun was, viewed in present lights, a slipshod, unsatisfactory sort of process. Much was taken for granted after the piece had demonstrated its ability to hold together during the strain of discharge. There were few of the "niceties" of gun-test. But now the proving of a gun is a careful and methodical operation. Not only must it hold together, but it must demonstrate its intention to hold together under rapid and continuous use, and it must show itself capable of giving the projectiles a high velocity and a comparatively flat trajectory.

For testing the velocity of the projectiles a chronograph is used, which in this case consists in a general way of three parts—a powerful magnet, a steel rod and a knife-blade. The chronograph is mounted in a structure set at considerable distance from the emplacement upon which the gun to be tested is mounted. This is to obviate jarring when the piece is discharged . At the top of the machine is the powerful magnet which, when the current is closed, holds the rod suspended. The rod hangs over an aperture in the base of the instrument, and at one edge of this opening a knife-blade is placed and held back against a spring by another electro-magnet. The brick foundation upon which the instrument is built goes many feet into the ground in order that the greatest stability may be obtained.

To return to the gun, two square frames are erected on the line of fire, the first one a hundred yards from the muzzle of the gun, and the frames exactly one hundred yards apart. Back and forth across these frames is a network of wires; or rather a cross-weaving of one wire which runs from the frame to the instrument in the distant house, and is connected with the electro-magnet which holds the slender steel rod. The second screen is like the first, save that its wire runs to the second electro-magnet, the one holding back the knife-blade at the base of the chronograph.

Then, with the current on, the rod suspended, the knife-blade restrained against the spring, the gun is fired. The projectile pierces the first screen, the wire is broken, the circuit is opened, the magnet is demagnetized instantly and the rod drops. The projectile speeds across the hundred-yard space and pierces the second screen, breaking its wires and breaking the electric circuit. This releases the knife-blade, past which the rod must fall, and, energized by the spring, the blade flies forward and strikes the rod, making a minute nick upon it. By this time the projectile has flown into the great sand butt and buried itself, and the nicked steel rod has dropped into a sand-filled receptacle. The velocity has been denoted by the utilization of the law of falling bodies. A body will fall $16\frac{1}{2}$ feet the first second, 33 feet the second, and so on in this ratio until it reaches earth. Applying this principle to the rod, it is known that its foot was exactly at the level of the blade, so that measuring the distance from the foot to the nick, gives the space through which the rod has fallen. Then, remembering the gravity law, that a body falls $16\frac{1}{2}$ feet the first second, it is readily determined how long the shot has required to cover the 100 yards between the screens. This gives practically the initial velocity of the projectile.—*N. Y. Evening Post.*

* * *

Short circuits in electrical transmission lines sometimes happen in the most unexpected ways. Not long ago a lady shopper in Boston dropped a brass curtain rod from the platform of a Boston elevated railway station and it fell across one of the rails of the track and also across the third rail through which the current is transmitted. This short-circuited the system and tied up the line. At Hoffman, N. Y., a still stranger accident happened. A cat, of an investigating turn of mind, climbed a pole of the Buffalo and Lockport Electric Railway and attempted to do a tight-rope act on one of the feed wires. Her tail brushed against one of the 22,000-volt lines of the Niagara transmission system, near-by, and she suddenly had one life less to live. The body of the cat short-circuited the current and the power was shut off at Niagara for two hours in consequence.

FIXTURES AND TOOLS FOR MAKING SPEED INDICATORS.

JOSEPH VINCENT WOODWORTH.

The sketches herewith are of two special chucks and of a tapping machine which were designed by Mr. W. J. Parker,

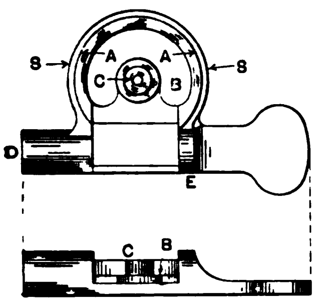


Fig. 1. Sketch of Indicator.

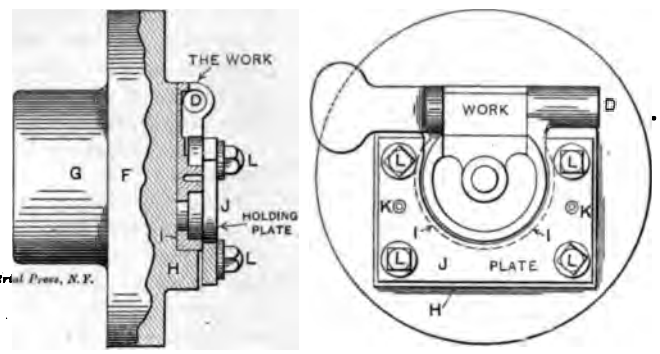


Fig. 2. The Chuck for First Operation.

foreman of the Fulton Machine Works, Brooklyn, the chucks being used for machining a casting which forms the body of a speed indicator manufactured by that firm. The work on this casting was the boring out of the large circular portion *A* for the revolving dial plates of the indicator; the facing of the

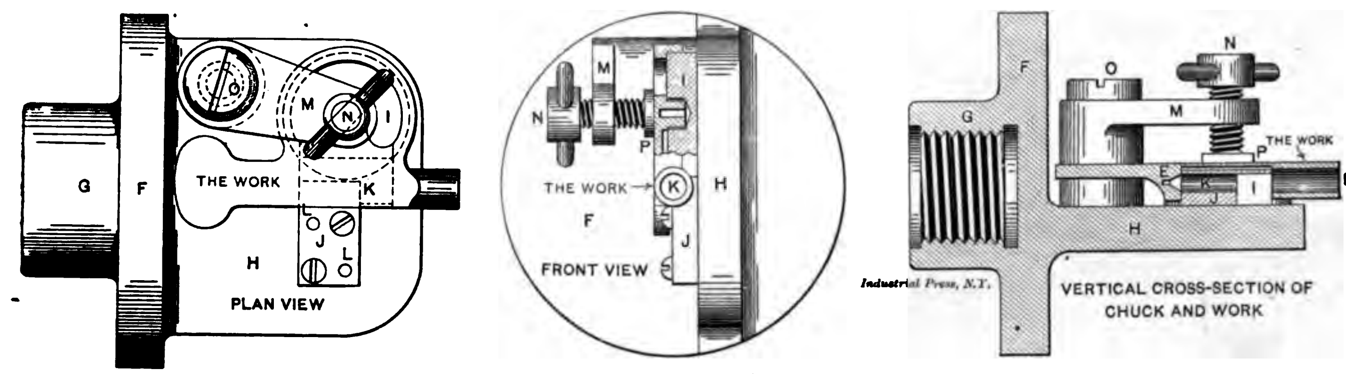


Fig. 3. Three Views of Chuck for Second Operation.

bottom *B*, and of the hub around which the dials revolve, and the drilling of the small hole *C* in the center of this hub. All this was accomplished in one operation, after the work had been fastened in the chuck, Fig. 2. The second operation was the boring and reaming of a hole *D*, Fig. 1, for the spindle

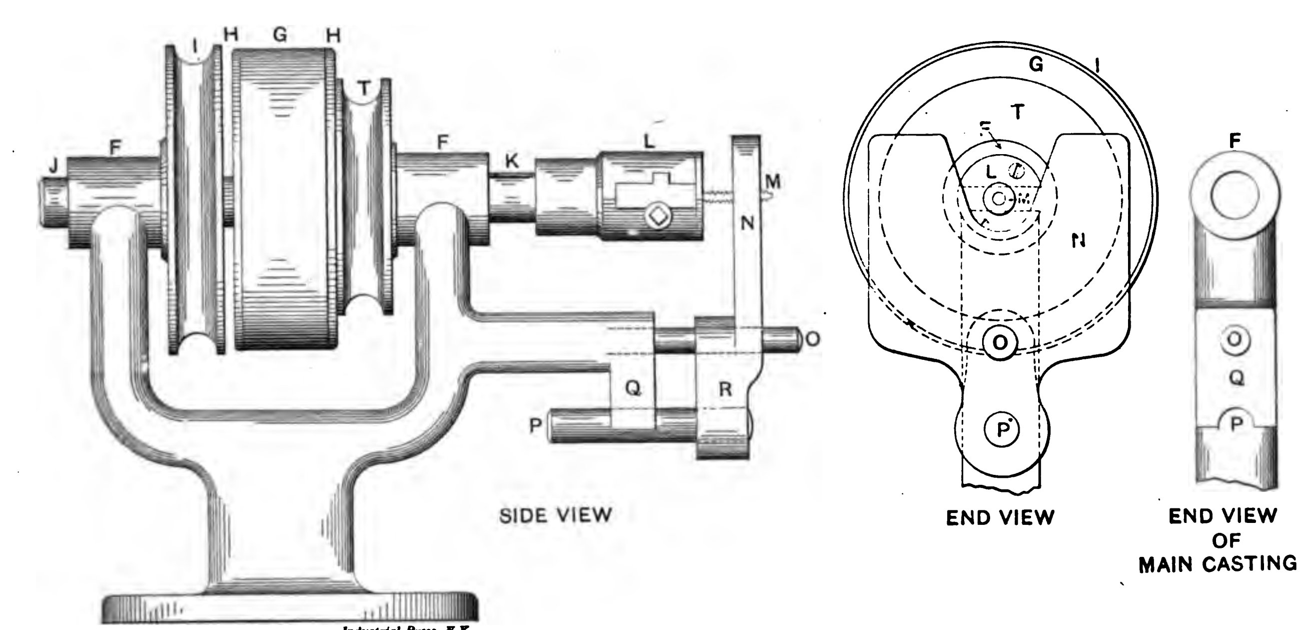


Fig. 4. Small Tapping Machine.

of the indicator and the finishing of a center end thrust bearing for the end of it at *E*. Both chucks are to be used in the screw machine in conjunction with a set of turret tools for each.

Fig. 2 shows the chuck used for the first operation and consists of a circular casting having a hub at the back and a raised portion on its face for holding the work. The casting is fitted to the screw machine spindle, and faced and bored to admit the large circular portion of the work as shown at *I*, being bored to a depth sufficient for the upper side of the work to project slightly above the face *H* of the chuck. The face of the chuck is milled away on each side of the square central portion *H*, so that the work may be easily located or removed. *J* is a flat machine steel plate, located on the face of the chuck by two dowel pins, *K K*, and fastened by the four corner screws *L L L L*. This plate, while fastened to the main casting, is bored sufficiently to tightly clamp the edges of the large circular portion and for clearance for the cutting tools. Fig. 2 shows clearly how the work is located and clamped on the chuck. The work is machined by the usual type of turret tools.

The second operation is accomplished by the use of the chuck shown in Fig. 3, which is of distinctly different design from that of the chuck, Fig. 2. It is a circular hub backed casting, with a rather long, flat, projecting standard at *H*, fitted, as in the other case, to the screw machine spindle and having the face of *H* machined flat and square with the face of *F*. The work is located on this projecting face at two points by *K* and *J*; also at *I* by a circular machine steel disk fitting within the portion *A*, Fig. 1, of the work and fastened to the face *H*, Fig. 3, of the chuck by screws and dowel pins (not

shown) and at K by the steel plate J, which, as will be seen, is fastened by screws and dowel pins. For clamping the work to the chuck the swinging bracket and clamping screw N are used, whose construction are clearly shown in the vertical cross-sectional view of Fig. 3, where the work is shown fastened upon the chuck. The work machined in these chucks is, needless to say, perfectly interchangeable.

Fig. 4 shows a small tapping machine which is compact, substantial and simple to operate and which was used for the rapid tapping of the small hole C in the work, Fig. 1. The main casting has a round flat base to be fastened to the bench and a bearing F at either end for the spindle K, on which is placed a wood friction pulley G, which has a leather face H H at each side. Two loose pulleys I and T are run at right and left of the friction pulley by means of circular belting from a small special countershaft, and between these loose pulleys and pulley G there is a space of about 3-32 inch. The end K of the spindle is turned taper for the chuck L. A sliding bracket N, having an opening in its face as clearance for the tap and for the small projecting surfaces of the work, squares and supports the work while the machine is in operation. The bracket slides easily back and forth on the stud O. which is driven into a hole drilled in the front extension of the main casting, and by the larger stud P, driven into the bracket at R and which slides into a semi-circular groove in the extension at Q.

When tapping work, the work is held against sliding bracket N, which is slid up against the tap. As the work encounters this tap the friction pulley G is forced against loose pulley I with just enough force to drive it and tap the hole. When the tap bottoms, a slight pull backward brings pulley G against the backing pulley T and the tap is withdrawn. Holes up to ¼ inch can be rapidly tapped by this machine and the tendency of the tap to break off is eliminated as far as is possible, as just enough friction is exerted to drive the machine and tap the hole.

* * *

Captain John Lawson, who assisted in the building of the first locomotive constructed under the direction of George Stephenson, died at St. Louis, Mo., November 21. He was born in Manchester, England, August 8, 1805, and when still a boy was apprenticed to Stephenson. He was a locomotive engineer for many years on different railways in the United States, but finally abandoned railroading for the steamboat business on the Cumberland River, following which he accumulated a fortune. Mr. Lawson had seen during his lifetime the inception and development of the railway, which is now one of the chief factors in the commerce of all civilized countries.

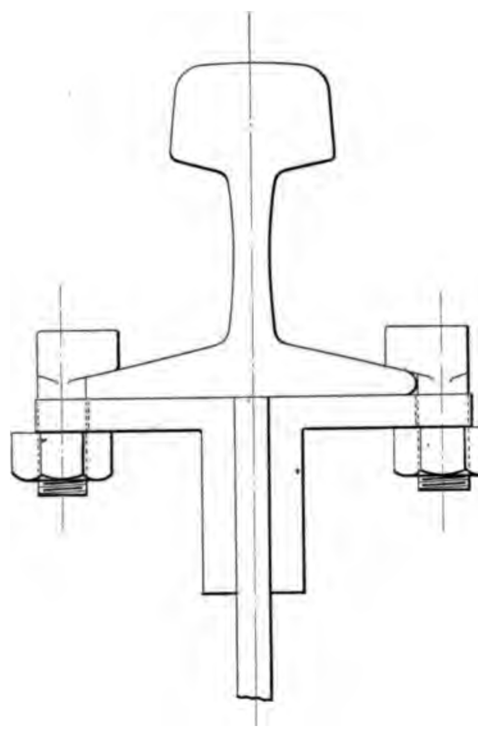


Fig. 1. Faulty Construction.

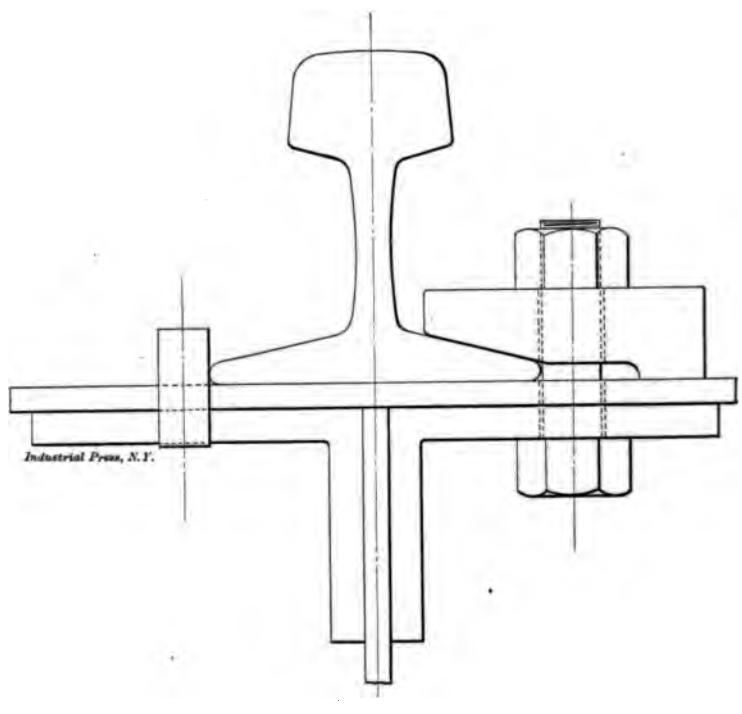


Fig. 2. Improved Construction.

TRACKS FOR TRAVELING CRANES.

K. B.

Every up-to-date foundry and machine shop should have, among its other equipments, one or several electric overhead traveling cranes. As is well known, these cranes consist of a trolley carrying the hoisting mechanism, which has an easily controlled motion on a pair of steel girders, forming a bridge that spans the width of the building and travels on a track or runway extending over the whole length of the building, so that nearly every part of the floor area may be reached by the crane hook. The tracks are usually laid on steel girders, carried on brackets or posts riveted to the building columns—assuming that the building is made of steel framework.

In providing for traveling cranes in a building it is not only necessary that the columns and girders carrying the cranes shall be made strong enough to carry the superimposed load of crane and greatest weight lifted, but that a liberal allowance be made for vibration and shock. When a crane weighing, say, about 35 tons, and carrying a load of 25 tons, travels with a speed of more than 200 feet per minute, the momentum produced if the crane is brought to a sudden stop will cause considerable strains in the building. The building columns must, therefore, be well braced, the crane girders must have great lateral stiffness, and the tracks must be firmly secured to the girders. This latter is, however, a detail that does not always receive the attention it requires. No engine or other machinery will run well on a loose foundation, nor can a traveling crane be kept in good running order on an insecure track.

The writer once had occasion to examine a crane runway in a steel mill, where a number of cranes for handling steel ingots at the heating furnaces had been in constant service for several years, with the exception of Sundays. These crane girders were made up of a web plate and four small angles and were, no doubt, strong enough for static conditions, but did not have sufficient lateral stiffness. There was, therefore, a considerable side deflection in evidence when the cranes were running. Fig. 1, showing a section of part of the girder with the rail in position, is here given as an illustration of how the track should *not* be made. In this case the rails were held down by means of ¾-inch hook bolts which, as the girder was not much wider than the base of the rail, were placed near the edge, thus affording very little hold for the nut on the underside. The vibration had caused many of these nuts to work loose and the bolts to turn the hook side away from the rail. Consequently the rails were loose and seemed very

near being carried off the girder with every movement of the rapidly operated cranes. The flanges of the truck wheels were badly worn, and the rails were worn unevenly. It is obvious that such an uneven, imperfect track, causing the crane to skew and bind, cannot but have an injurious effect on the mechanism of the crane. It is remarkable that while repairs were continuously made to these cranes, no attention was paid to the unsatisfactory condition of the track.

A method of holding down rails for crane runways which, in the writer's experience, has proved very satisfactory, is shown in Fig. 2. For tracks ordinary steel rails of about 70 pounds' weight per yard are mostly employed. The rails are secured to the girder by means of ⅞-inch bolts and cast-iron clamps 3 inches wide. As a properly designed crane girder should have wide angles and cover plate at least in the top flange there is usually room for this clamp with the bolt in the center. In addition to these clamps ¾-inch steel dowel pins are driven into the girders close to the edge of the rails, the holes for these pins being drilled after the rails have been properly set and clamped. The clamps will hold the rails firmly to the girder and the dowel pins serve as a safeguard to prevent any side slipping of the rails. Fig. 3 is a plan view showing the proper spacing of the clamps and dowel pins.

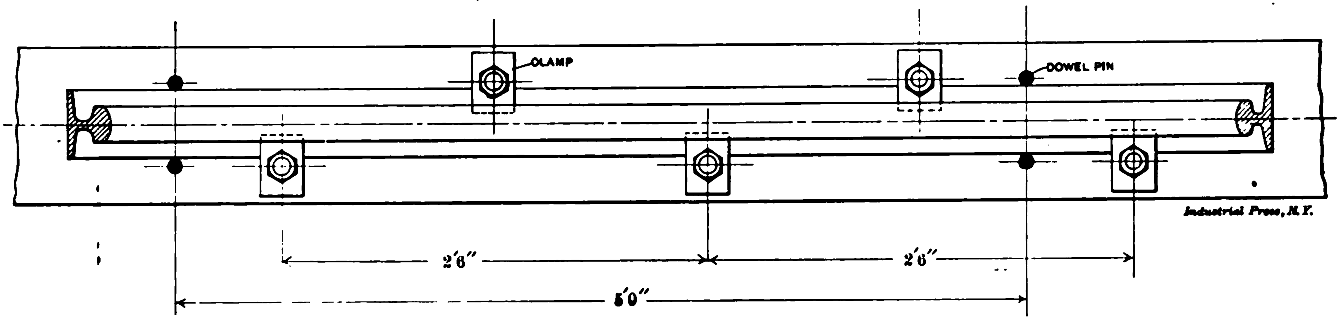


Fig. 3. Plan of Track and Girder.

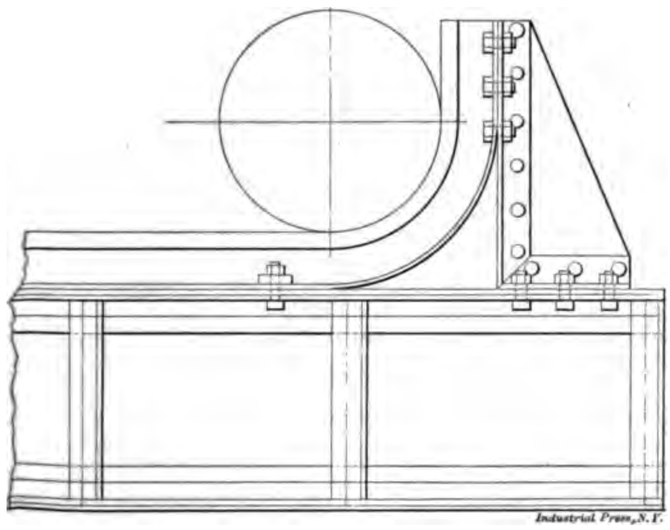


Fig. 4. Crane Stop.

Sometimes when greater stiffness in crane girders is desirable on account of large span, box girders are employed. In that case the rails have to be bolted down with tap bolts, but otherwise they are bolted down as in Fig. 2. These holes must be drilled and tapped "in the field" after the girders are erected.

Most traveling cranes are provided with brakes, not only for the absolute control of the suspended load but also for checking the speed of the trolley or the bridge, and for gently bringing the crane to rest. The brakes are either automatic magnetic brakes, operated by a pair of solenoids, or mechanical hand- or foot-power brakes. Sometimes both kinds of brakes are used on the same crane. But as an additional safeguard there should be stops provided on the track, and for this purpose there is either a cast-iron shoe bolted to the rail or the end of the rail is bent up. Neither of these stops is altogether safe, however. If the crane, through failure of the brakes to work in time or through the operator's carelessness, should approach the stops under great speed it may ride over the cast-iron shoe or the curved rail end, violently struck, may snap off. The latter case once came under the writer's observation.

A good stop is shown in Fig. 4. It consists of a riveted steel bracket which is bolted to the girder, the end of the rail being curved to a radius to conform to the wheel and being bolted to the bracket.

If the trolley stands near the end of the bridge, and the latter is set in motion, there is danger of its being run against and damaged by the knee braces for roof trusses in the building. To prevent this the stops illustrated should be placed on the bridge also, and at such a point as to keep the trolley at all times clear of any obstructions.

* * *

PROPORTIONS FOR COLLARS.

Geo. W. Childs.

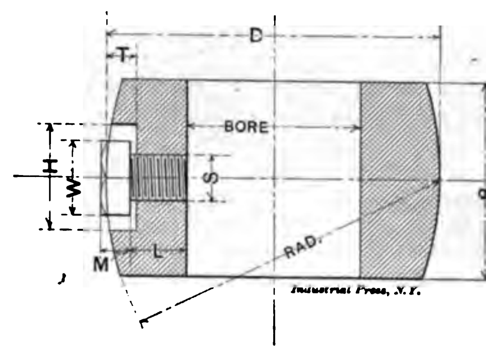


Table of Dimensions.

Bore.	B	D	H	L	M	S	T	W
1 7/16	1 5/8	2 3/4	7/8	17/32	3/16	3/8	1/4	5/8
1 9/16	1 3/4	3	7/8	19/32	3/16	3/8	1/4	5/8
1 11/16	1 7/8	3 1/4	1	19/32	1/4	1/2	5/16	5/8
1 15/16	2	3 5/8	1 1/4	19/32	5/16	1/2	3/8	3/4
2 3/16	2 1/8	4	1 1/4	21/32	5/16	5/8	3/8	15/16
2 7/16	2 1/4	4 3/8	1 1/4	23/32	5/16	5/8	3/8	15/16
2 11/16	2 1/2	4 3/4	1 1/2	25/32	3/8	5/8	7/16	15/16
2 15/16	2 5/8	5 1/4	1 1/2	27/32	3/8	3/4	7/16	1 1/8
3 3/16	2 3/4	5 3/4	1 1/2	1	3/8	3/4	7/16	1 1/8
3 7/16	2 7/8	6 1/4	1 3/4	1 1/16	7/16	3/4	1/2	1 1/8
3 11/16	3	6 3/4	1 3/4	1 3/16	7/16	7/8	1/2	1 5/16
3 15/16	3 1/8	7 1/4	1 3/4	1 5/16	7/16	7/8	1/2	1 5/16
4 3/16	3 1/4	7 3/4	2	1 7/16	1/2	1	9/16	1 5/16
4 7/16	3 3/8	8 1/4	2	1 1/2	1/2	1	9/16	1 1/2
4 15/16	3 5/8	8 3/4	2 1/4	1 1/2	9/16	1 1/8	9/16	1 1/2
5 7/16	3 7/8	9 1/4	2 1/4	1 1/2	9/16	1 1/8	9/16	1 5/8
5 15/16	4 1/8	9 3/4	2 1/4	1 1/2	9/16	1 1/8	5/8	1 5/8
6 7/16	4 3/8	10 1/4	2 1/4	1 1/2	9/16	1 1/8	5/8	1 5/8
6 15/16	4 5/8	10 3/4	2 1/2	1 7/16	5/8	1 1/4	11/16	1 3/4
7 7/16	4 7/8	11 1/4	2 1/2	1 7/16	5/8	1 1/4	11/16	1 3/4

* * *

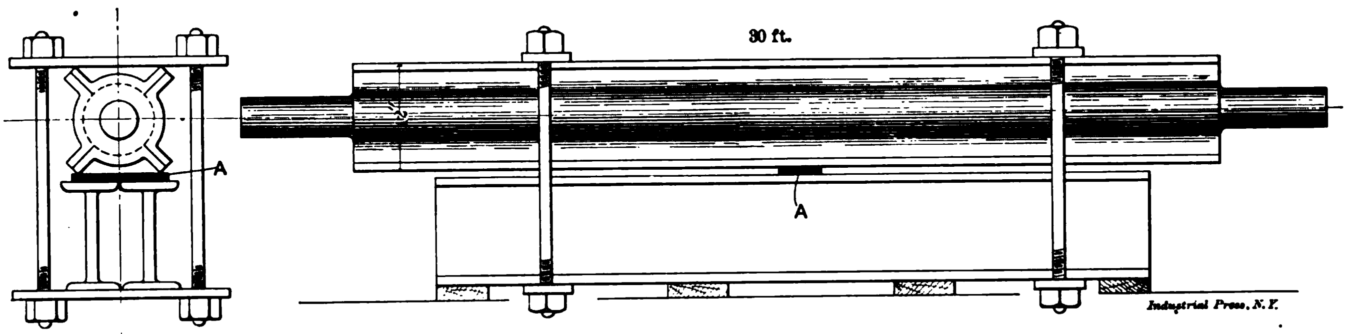
Reports of the discovery of a wonderful steel come from Berlin, Germany. A German, Herr Sieblen Giebler, is reputed to have discovered a steel which hardens like tool steel and which may be used for tools. Its alleged remarkable qualities, however, are that it is 140 per cent stronger and 50 per cent lighter than Krupp, Harvey and Bohler steel and costs one-third less.

LETTERS UPON PRACTICAL SUBJECTS.

STRAIGHTENING A THIRTY-FOOT SHAFT.

Editor MACHINERY:

The illustration shows clearly the method recently pursued in straightening a large, built-up shaft that had been badly bent by passing through a fire. The shaft was built up of channel irons, weighed 1,800 pounds and ran at a speed of 150 revolutions per minute. It was first attempted to straighten the shaft by supporting the journals in bearings, and then building a fire under it, and when the shaft was hot, to straighten it by means of a long lever, as railroad rail. It did not take long to demonstrate that this was an almost impossible task; in fact, the shaft would not retain its shape while cooling.



Straightening a Shaft of Peculiar Construction.

The next move was to take two 15-inch I-beams, which, by chance, happened to be at hand, level them up solidly on some pieces of plank and then strap the shaft to the I-beams, as shown in the illustration. The high place in the shaft was turned toward the I-beams and a distance piece about one inch high was placed between the shaft and I-beams, the two ends of the shaft being then sprung down to the I-beams by means of heavy clamps, as shown. The shaft was allowed to remain in this position four or five hours, when the clamps were removed and the next high spot was treated in a similar manner. The shaft was straightened cold and at the end of three days was perfectly true.

Had the shaft not been a spare shaft, the work might have been hastened by building a little wood fire on the shaft over block *A*, after it had been drawn down by the clamps, then heating a small part of the shaft, withdrawing the fire and cooling off the shaft quickly and slacking up on the clamps. This was not necessary, however, and is only offered as a suggestion.

The cost of doing the work was slight; it took one blacksmith and helper only a few minutes two or three times a day to do the work, and as a new shaft would have cost $250 it was evidently a paying investment. A. H. ELDREDGE.

So. St. Joseph, Mo.

* * *

RECOLLECTIONS OF A COUNTRY JOB SHOP.

Editor MACHINERY:

I had worked in the shop about a year when a new man came in to work. Now, it was not often that we put on a new hand, as the old ones seldom used to leave, and business remained about the same week in and week out, only that during a part of the year we had to put in a good deal of overtime on sawmill repairs.

Well, this new man was just over, and although he was nobody's fool, he was as green as grass. The Old Man gave him a job of turning up some short bolts and threading them. He commenced all right, centered and drilled them and then started for a lathe. Now, we had a lathe in the shop that you don't meet with nowadays, and it is just as well that you don't. It was an old style chain feed, with a handwheel for moving the carriage up at the head end, and the only way one could square up a piece of work was by continually knocking against the side of the rest so as to jar it along. The new man got his work in all right, but he could not find any way to move the carriage; so he braced his foot against the tailstock and moved it by main force. Then he went off to get a tool, but while he was gone one of the boys locked the feed so that the carriage would not move. When he came back with his tool, he tried the same trick, but it would not budge a mite. What did he do? Why, he left it just where it was, put in his work and with a couple of hand tools turned up those bolts and chased the thread on them. He did a good job and was not long about it, either, and if I had not seen it done, I would not have believed it possible to do it in that manner.

A few days after this I was running the planer when he came along with a steel key, off of which he wanted to take ¼ inch. He saw that I was busy on a long job, and he said: "Oh! never mind; I'll chip him," and "chip him" he did. It was a tool steel key, 1 by 5 inches, and he put it into the vise, took one of those wide, fan-shaped chisels and took off that ¼ inch nearly as quickly as it could have been planed. It gave me an insight as to what could be done with a chisel if one only knew how, and it gave me a respect for the man also.

When the new man had been there a week or more, the Old Man gave him a good job to do and a good lathe to do it in. It was a couple of small crankpins for a sawmill engine. Well, he roughed them out, took a light finishing cut all over them with the lathe in gear, then asked the Old Man to look at them. "They are all right; take out the back gears and polish them up," and with that the Old Man went off to look at a job that had just come in. When he got round to "Greeney" again he found that the latter had pulled the headstock apart, taken out the back gears and was polishing them up. Now, the Old Man was a church member, and so could not do justice to his feelings as he would have liked to, but by the way "Greeney" looked when his employer got through with him there was no doubt but that he understood what was wanted.

One day a team drew up with a shaft on it that was over ten feet longer than the long lathe. It was a sawmill job; one of those old, square shafts with bearings turned in it where the boxes came. The mill man was on the team, and he wanted an extra bearing three feet from the end. Here was a sticker. We could not put a center rest on it for we had no "cathead" to fit it. The Old Man measured it, chewed a straw awhile, and said, "Dump it out, you can have it tomorrow night," and went home. Next morning, bright and early, he was down with a leveler's compass and a rip saw. The long lathe stood at the end of the shop, and there was a hole in the wall that we had made to run a shaft out of. Outside the shop, about ten feet away, was a big apple tree. The boss drew a line level with the worms of the lathe, sawed off the tree at the line and bolted the tailstock on the stump, put in the shaft and turned in the extra bearing. The whole job took two men 7½ hours, and it all went in the bill, and the mill man paid it, too. I never knew whether the stump was inventoried as a tool or real estate.

Take it all in all, the boss was all right; he paid as good wages as any of the town shops, and double time for overtime (and charged it in the bill, too), and never would let a stroke of work be done Sunday, "not if he knew it." Sometimes we did a little when we were out on a job, but it never went on the bill, or the payroll, either. He used to take us

boys for a sail up the river about once a year, and also let us help get in the hay on the farm when haying time came and work was slack in the shop. When I was out of my time he got me a place as engineer in a large straw manufactory, gave me a copy of "Chordal's Letters" (a better gift to an apprentice boy it would be hard to find) and a lot of good advice. My wanderings since leaving the old shop have covered a good deal of territory, but my mind often goes back to that little country shop and the ways and means we had to use to get out the jobs. A. P. Press.

* * *

ADJUSTABLE SPECIAL TAP.

Editor Machinery:

The sketch herewith illustrates a very convenient form of collapsible tap intended to tap out holes located in out-of-the-way places, such as shown at *C*, Fig. 1. The hole shown here is located in the center of an iron column, 2½ feet from the opening in the end, and is therefore hidden from the eye of the operator. As will be seen by the sketch, the body *B* of the tap, Fig. 1, is provided with boring tools shown at *A*, whose duty consists in preceding the tap through the hole to be tapped and sizing the same for the reception of the tap proper. When the cutters *A*, Fig. 1, have passed through the hole the operator simply continues to feed the drill spindle (to which the shank *J* is attached) downward until the threaders *D* engage the bored hole and tap it. After the thread is cut the operator pulls the handle *K* in the direction of the arrow, Fig. 2, which causes the threaders to close in and the tap can be withdrawn without the usual backing out.

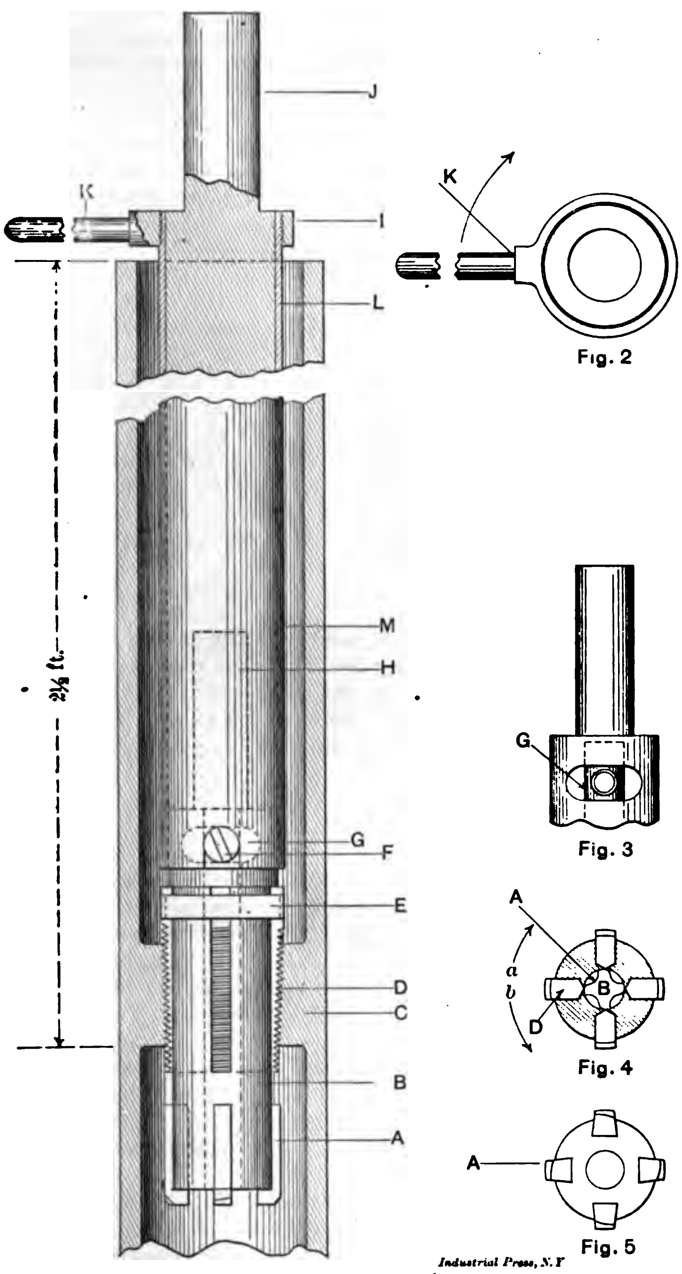


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

Details of Tap.

The handle *K* is attached to a wrought-iron ring screwed and riveted on a piece of gas pipe *L*, Fig. 1, which encases the main shank *M* into which the shank *H* of the tap proper is fitted. This shank is slotted, as shown in Fig. 3, to allow a screw *F*, Fig. 1, to connect the outer pipe with a shaft *G*, Fig. 3, and also to permit the latter to rotate when handle *K* is operated. The lower end of shaft *G* is fluted to form four cam surfaces, as shown at *B* in Fig. 4, which bear against the threaders *D*.

By pulling the handle, as before mentioned, shaft *B*, Fig. 4, is turned a quarter turn and threaders *D* are forced into the milled grooves *A*, Fig. 4, by the spring band *E*, Fig. 1, when the tap can be withdrawn.

The features of the tap are the combined boring tool and tap and the doing away with backing out the tap.

Brooklyn, N. Y. George J. Winkle.

* * *

A POINTER ON HARDENING TOOLS, ETC.

Editor Machinery:

It is a known fact that in order to get the best results from quenching tool steel in a strong brine it is necessary to have the steel at the lowest heat at which it will harden. I have found out by experience that steel will harden at a much lower heat in a strong brine—say 20 pounds of rock salt to 50 gallons of rain water, thoroughly dissolved.

Now to come to the point, we all know that an easy way to harden tools is by quenching only the point or end of the tool for about one or two inches, then brightening same with emery cloth and letting the color "run." My method of doing this is to get the steel heated very slowly to the lowest possible red at which I think it will harden, then to quench it in the usual way, having previously placed a small smooth flat file at hand, and before the color has a chance to "run" to try the steel for hardness with the file. If it proves hard, brighten it and watch the color; if soft, immediately place it back in the fire and in very short order you can get it up to a little higher heat than previously and then go through the same routine. I find I am generally successful the second time and am sure of a good temper without having wasted much time. Harry Ash.

Chicago, Ill.

* * *

METHOD OF GRADUATING ANY SPECIAL SHRINK RULE BY HAND WORK.

Editor Machinery:

Pattern makers and others often wish to obtain some special shrink rule not on sale or usually made. The sketches herewith show that by care a judicious workman may construct, by hand-graduating, any special rule he wishes to possess.

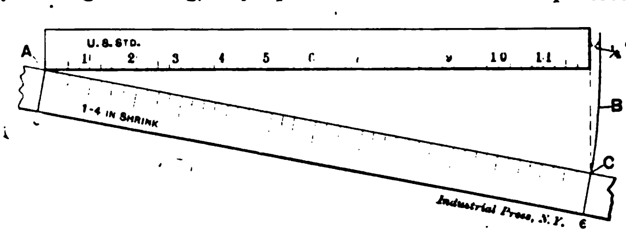


Fig. 1.

Fig. 1 shows a U. S. standard rule as the guide to a spacing shrink rule; fasten this standard rule to a board by some means which leaves the top of the rule without obstruction; then locate the blank for the rule to be marked (usually a piece of boxwood, mahogany or cherry), as shown in Fig. 1, then add the amount per foot desired for shrink to the 12-inch standard rule, and from *A* scribe arc *B* to connect with the right angle of line of the rule end at *C*. Now fasten the blank in position, leaving the top of the blank clear for marking.

Having located and secured the standard rule and blank in proper position, the next thing is to get out a marking gage, as shown in Fig. 2, at *F*. Make this gage of thin sheet steel, turning down at *O* as a guide for the gage. The correctness of the marking of the blank will depend on three or four items:

Correctness of the standard rule; correctness of location of the blank; uniformity of setting the gage at *X*, and mark of the line at *T*. Care must be taken that the line cutting tool be not thick and blunt, and that it be held the same way each time a line is cut. The writer has used for this purpose a special tool which is always guided alike at each marking; that is, in an upright position. A good expert workman can, even by hand, thus produce a shrink rule which will make

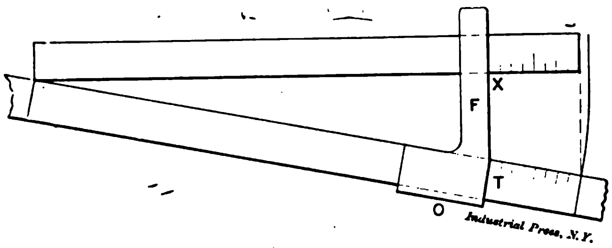


Fig. 2.

some of the cheap wood rules blush. I have a sample of one of these cheap "wiggle" line rules in my possession at the present time. This graduating machine is not a costly affair, and it can get any special rule you want if you handle it right.

When marking, cut light lines at *e e*, and then cut off the blank at these lines.

F. W. Clough.

Springfield, Mass.

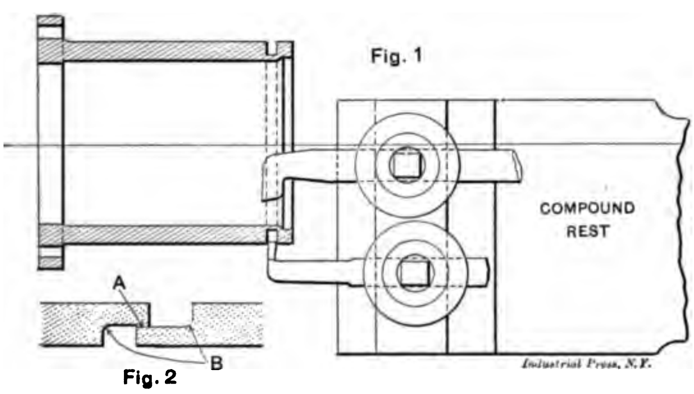
* * *

ANOTHER METHOD OF FINISHING THIN RINGS

Editor Machinery:

In both August and October Machinery I find that some of your readers have had trouble in finishing thin cast-iron rings parallel on both sides. The method here described is simple and very satisfactory for making piston rings or other rings of a similar nature. I have nearly always made these rings eccentric.

I have my castings made with lugs, as described by "Nemo" in the October number, but for the small sizes, 3 and 4 inches in diameter, I find it necessary to cast the lugs on the outside of the rings in order to bolt them to the faceplate slots, as these slots do not generally come near enough to the center of the plate to allow bolting the small sizes from the inside.



The first operation is to face off the bottom or lug part of the casting and bolt it to the faceplate of the lathe. Then turn it to rough sizes, both inside and out, and loosen up all of the holding bolts but one, to let the spring or strain out of the casting. Now, clamping it again, turn the outside to finished dimension. When this is done, move the casting over the faceplate a sufficient amount to give it the desired eccentricity of bore. This makes the ring elastic, or, in other words, gives it a good backbone. In sizes of rings ranging from 8 to 18 inches, I make a difference in thickness of 1-16 to ¼ inch. Now bore the inside to within about 1-16 inch of the finished size. The finishing is done with a boring tool and a cutting-off tool placed side by side in a compound rest which is set at 90 degrees. This gives two tools in readiness for use, as will be seen by reference to Fig. 1.

Now, with the cutting-off tool, make a groove in the casting a little further from the end than the finished thickness of the ring, and a little deeper than the finished diameter of the bore. With the boring tool face off the end of the ring to exact width, thus making both sides parallel; and with the same tool bore out the ring to exact size. When the groove made by the cutting-off tool is reached by the boring tool the ring will be completed.

I cut these rings as shown in Fig. 2, as I find that rings cut on the slant will break very easily when used on steam hammers, or wherever there is a heavy blow or jar. Rings cut in this way must be very accurately made, without play room at *A*. The lower half must support the upper half and have rounded corners at *B*.

A. J. D.

Neubrandenburg, Germany.

* * *

MORE TALK ABOUT CRANKS.

Editor Machinery:

I was much interested in Mr. C. W. Putnam's method of finishing cranks, published in the July number, and "Nemo's" method, described in the October number of Machinery. I would machine the crank as Mr. Putnam suggests, when I had suitable parallels, but if I had not I would machine it according to circumstances, which would take a little more time, but would not injure the quality of the job.

When the cranks are 10 inches stroke or larger I almost always find it better to finish the rim after the shaft is pressed. I do not see the necessity of so much laying off; for I have never yet seen a case where more than the following was necessary, and generally less will do:

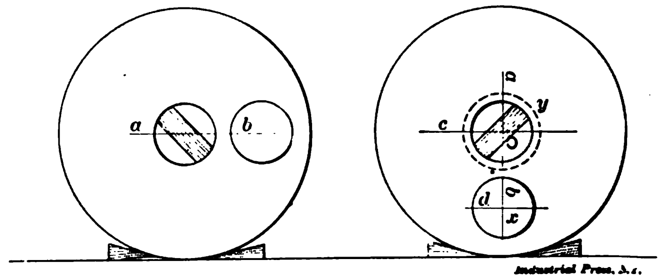


Fig. 1. Fig. 2.

Put a stick in the back of the shaft hole and on it find the center of the hole with the hermaphrodite caliper. Find the center of the pin in front in the same way. Place the crank on a flat surface, and with two or three wedges block it up so that the faces are perpendicular to the plate, and so that the two centers previously found are at the same height, as in Fig. 1. Now with a surface gage set to the same height as these centers, draw line *a* on the back of the crank and across the stick; and draw line *b* on both ends of the pin, as in Fig. 1. Next roll it over till lines *a* and *b* are square with the plate, as in Fig. 2. Draw line *c* on the back of the crank and across the stick, and line *d* on both ends of the pin. Lines *c* and *d* are drawn a distance apart equal to one-half the throw of the crank, and as close as they will come to the first centers found. Where these lines cross at *o* on the stick, and at *x* on both ends of the pin, will be the correct centers of the shaft and pin. If the stick must be removed in putting the crank in the lathe, it is well to draw circle *y* from center *o*, so that *o* can be found again, as it is much easier to true up a hole in a casting from the center than from the edge.

When the throw of the crank must be within 1-32 inch of being correct, it is best to place an arbor of some convenient size between the lathe centers and to caliper from it to the crank-pin.

The only tool I ever found better than the universal square and center head to locate a keyseat with, was a jig. "Nemo" should remember this, so that if he has another crank to lay out and has to center both ends of the pin, the moss will not be growing on it while he hunts up the parallel strips, V-blocks, straps and bolts which he told us he used. Should his crankpin be like the majority of such castings, he would have trouble enough to make the faces of the disk stand square when he tightened up the nuts.

Crank.

TESTING DUPLEX PUMP VALVE MOTIONS.

Editor MACHINERY:

It is occasionally necessary to test valve motion stands on duplex pumps, as, for instance, when traveling the pump it is found that at the end of stroke the valve moves too far, or not far enough. After inspecting the valve and other parts of the machine, and finding they are built according to drawings, our attention is naturally called to the valve motion. To avoid removing this motion from the machine, in cases where we can work trammels without interference from cradle or yoke, the following method may be used, as illustrated in Figs. 1 and 2.

First, a pair of trammels must be had which will take one of Starrett's ball attachments, as at *L*, in Fig. 1. Then, using the hole *H*, in the lever *M*, as a pivot for the ball, strike arc *A* on the short lever *N*, as shown in Fig. 2, and then, with the small ball in the dividers inserted in the center hole *O*, in the shaft for a center, strike the arcs *B B* to cut the arcs *A* at *C C*. With *C C* as centers, strike the arcs *D D D D* with equal radii, and then a line *E*, drawn through the intersections of these arcs, will be proper center line for the short lever to make it exactly parallel with the longer lever *M*. This will show how much the hole in the short lever is out of line and will thus determine exactly what is to be done to rectify the same. C. W. PUTNAM.

Holyoke, Mass.

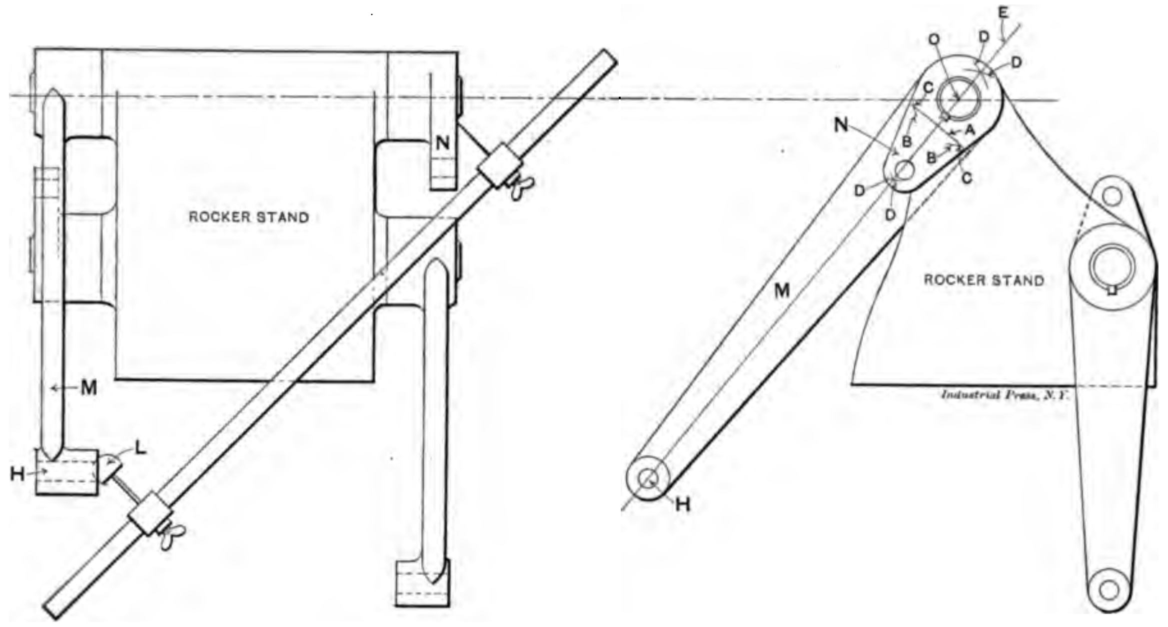


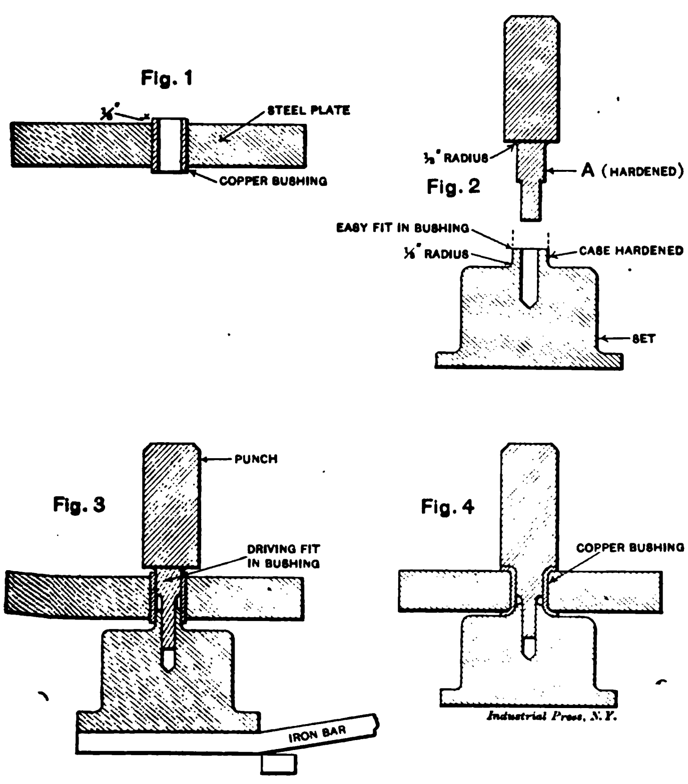
Fig. 1. Use of Trammels in Testing Valve Motion. Fig. 2.

SETTING COPPER BUSHINGS—TEMPERING.

Editor MACHINERY:

I once had occasion to fasten a number of copper bushings into ⅝-inch steel plates in order to make it possible to solder in copper wire for conducting electric current, and at the same time insure a perfect contact. The bushings were ¾ inch outside diameter and ⅝ inch inside. The plates were placed in such a position as to make it necessary to bead top and bottom in one operation. Fig. 1 shows the copper bushing in place, being simply pushed through a ¾-inch drilled hole and allowed to project ⅛ inch on each side.

The tool used consisted of a punch and block, as shown in Fig. 2.



Beading Tool and its Use.

In using, the block was supported by an iron bar, as in Fig. 3, and the punch was driven in as in Fig. 4. The punch was a tight fit in the bushing, causing the latter to spread in the hole, thus making an excellent contact. The punch may be easily removed by first withdrawing the block and then prying against the teat of the punch with an iron bar, the bushing being held in place by the beading.

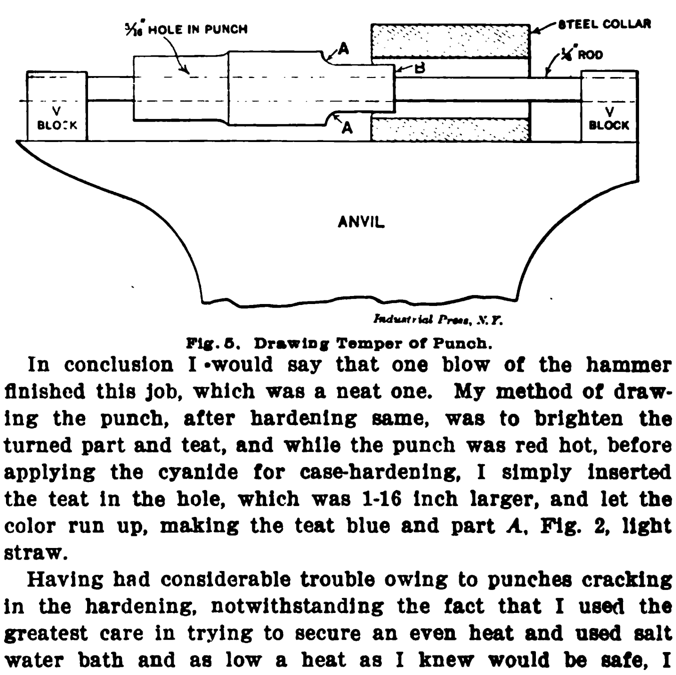


Fig. 5. Drawing Temper of Punch.

In conclusion I would say that one blow of the hammer finished this job, which was a neat one. My method of drawing the punch, after hardening same, was to brighten the turned part and teat, and while the punch was red hot, before applying the cyanide for case-hardening, I simply inserted the teat in the hole, which was 1-16 inch larger, and let the color run up, making the teat blue and part *A*, Fig. 2, light straw.

Having had considerable trouble owing to punches cracking in the hardening, notwithstanding the fact that I used the greatest care in trying to secure an even heat and used salt water bath and as low a heat as I knew would be safe, I decided to try a scheme of which I had heard previously. It is simply this: I drilled a small hole 5-16 inch through

the center of the punch—an operation which requires but little time. This is done in order to give the metal a chance to contract without the resistance which naturally takes place when there is no clearance for such contraction. Generally the presence of such a hole does not impair the efficiency of the punch. Since trying this scheme I have had no trouble resulting from cracked punches and do not expect that I ever will.

The sketch, Fig. 5, illustrates my method of drawing a punch, which had to be as hard as possible at the forming parts *A A*, and dark straw near the cutting portion *B* to stand punching and forming square holes in ⅝-inch machine steel, the top corners of which had to be rounded. I had two collars for heating, thus allowing one to be in the fire while using the other. Each collar had a flat which prevented its rolling off the anvil, and these two collars, used alternately, did the work in an entirely satisfactory manner.

ROBT. A. LACHMANN.

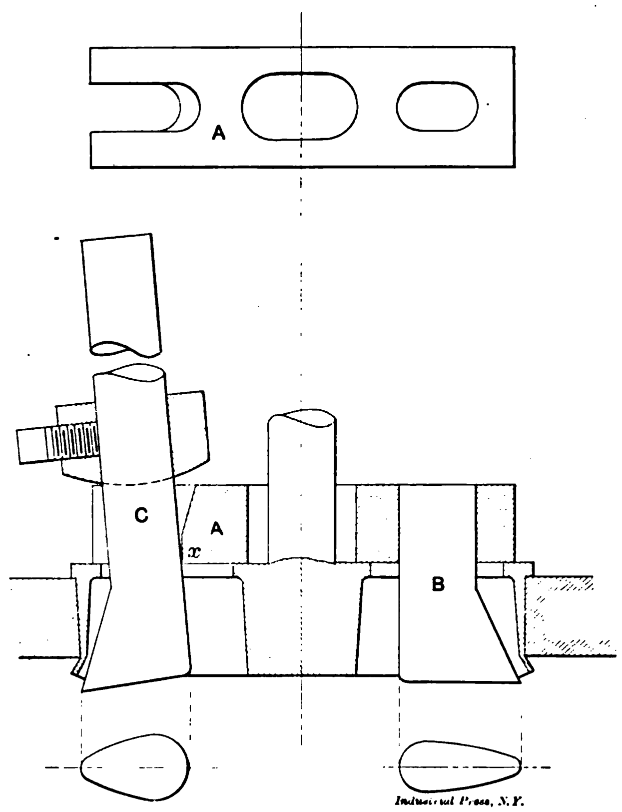
Chicago, Ill.

* * *

UPSETTING WATER VALVE SEATS.

Editor MACHINERY:

Enclosed you will find blueprint of a very useful device for upsetting the bottom edges of water valve seats, thus preventing them from working loose when once driven in. The seats should be made long enough so as to project through the casting about ¼ inch. Reference to the accompanying illustration will show the construction and method of operation of this device.



Upsetting Tool.

The strap *A*, shown in plan and also in sectional elevation, is provided with a hole at one end into which the boot-shaped piece *B* is fastened solid. The center hole seen in the plan view is made to fit around the valve stem; at the other end there is another slot, open at one end, in which the hand bar *C* is inserted. This bar carries a collar for adjusting the distance it shall project below or through the seat. By pulling on the top of said bar toward the center of seat, the lower end swings out, bearing against the strap *A* at *X*, and so forcing the piece *B* against the opposite edge of valve seat, crowding it out, as shown. WM. F. TORREY.

Quincy, Ill.

* * *

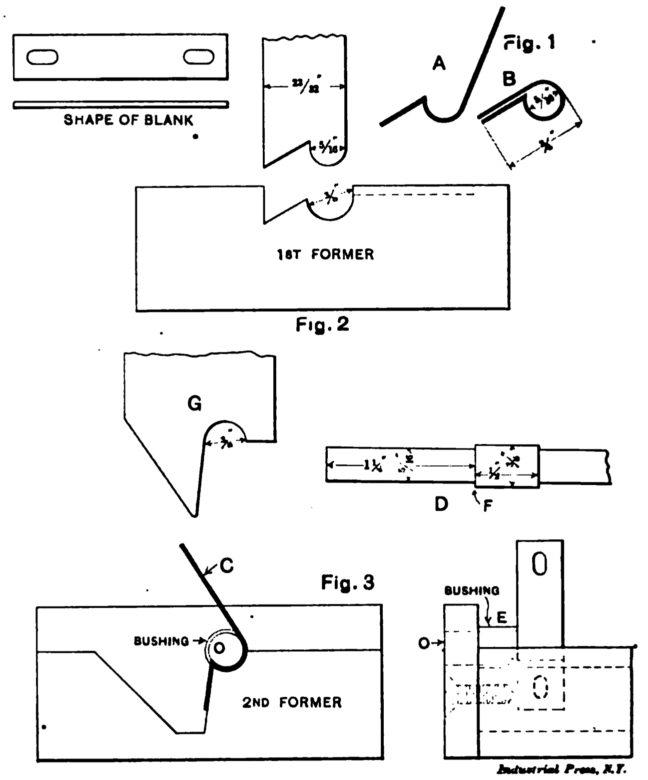
DIES FOR FORMING BINDING CLAMPS.

Editor MACHINERY:

I send you a sketch of a pair of forming dies which I think will be of interest. They are for forming binding clamps from punched blanks marked in the sketch "shape of blank." The completed clamp is of the form shown at *B*, Fig. 1.

The blank is first put on the former, shown in Fig. 2, and the punch is brought down, shaping the blank as at *A*, Fig. 1. The former for the second operation is shown in Fig. 3. In addition to the punch and die, there is a pin *D* and a bushing *E*, of the same outside diameter as the shoulder *F*, on the pin, while the hole is the diameter of the body of the pin.

The blank, which has been given the form *A* by the first



Forming Dies for Clamps.

operation, is now placed in this second former, as shown at *C*, and the pin *D* is put in place with the blank held between the bushing *E* and the shoulder *F*.

When in place, the shoulder *F* of the pin pushes the blank firmly against the bushing, the end of the pin being held in place by the hole *O* in the side of the former. The punch *G* is then brought down, and the point, just catching the end of the blank, forces it down and around the pin, thus giving it its completed shape. When desired, almost a perfect circle can be bent by this method. TOOLMAKER.

* * *

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

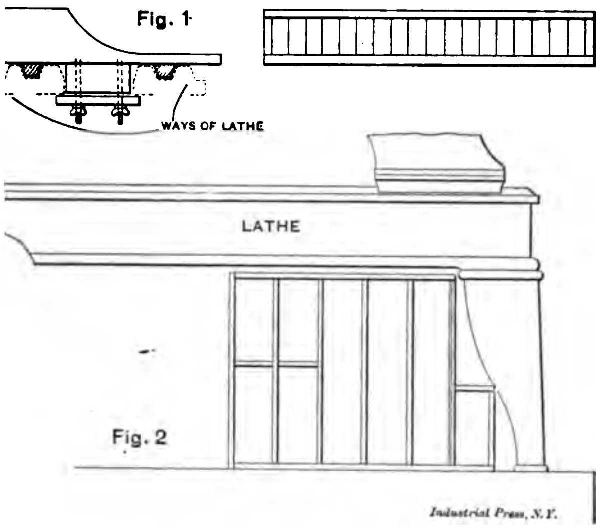
ALUMINUM KINK.

It is well known that aluminum is not readily soldered, and this peculiarity has been a great hindrance to its general use. Our contributor, James P. Hayes, however, instances a case where this peculiarity was taken advantage of in a gun shop and proved to be a positive benefit instead of a detriment. Iron wedges have heretofore been used for holding the two ribs in place between the barrels of a double-barrel shotgun while the barrels and ribs are being soldered together. The barrels are wrapped with bands of wire and the wedges driven under to tighten the bands. Great trouble has been experienced with the iron wedges being soldered to the ribs by surplus solder. Aluminum wedges were procured and have proved a success, as they will not stick to the barrels and fall off when the bands are removed. The wedges were cast from wooden patterns.

HANDY LATHE AND SHOP KINKS.

"Wabash" writes as follows: Instead of laying lathe tools on the shears or on a loose board, to be knocked down every time some one passes by, I had a board made like that shown

e sketch, Fig. 1. This board is clamped to the lathe ı the tailstock is clamped. I use a couple of wing nuts amping so that if the job is one that requires the whole h of the lathe, the board can be removed very easily. I ɜ the space between the top of the back part and the board into spaces which admit the lathe tools. This is by cutting, with a thin saw, a narrow groove in the s before they are put together, and slipping in pieces eet iron for the partitions, which keep the tools from g over. The shelf at the back is convenient to lay ɪrs, scales, etc., on, as they are apt to be injured when in the same place with lathe tools.



ɔther handy thing is a case for holding chucks, face- steady rest, etc., which may also be placed under the This is better than being obliged to dig them out of ɪips every time they are to be used. The case just fits the lathe, at the tail end where there are not many to gather on the top of the case. Of course, on large ı the case could not stand under the lathes but would to be put in some other place. See Fig. 2.

ɪd that a small brush and a tin can with a lid to it, hold- bout a quart of oil, are much better to oil the ways of .e or planer than a squirt can; one can oil the dovetailed much more satisfactorily. If one desires to oil the t parts, or calipers and other small tools, vaseline is for the purpose. Thin the vaseline with gasoline and with a brush. The gasoline evaporates and leaves on ɔols a thin coat of vaseline which will not turn black, ɜs machine oil.

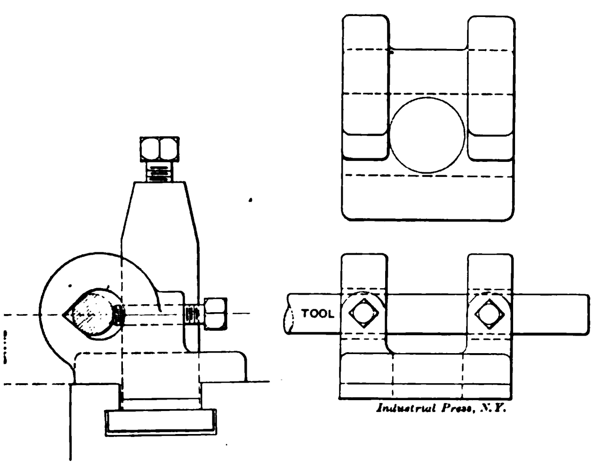


Fig. 3.

ou use lard oil when cutting threads, and soapy water rning, put each in a different style of squirt can, or else the cans different colors. This applies to the whole I know of a shop where they keep machine oil, lard d soapy water in squirt cans that are all alike, so that ı must squirt out some of the contents of the can to tell it contains, and thus he may waste more than he uses. ɪhaps he oils (?) the spindle with soapy water and uses rd oil for a water cut.

LATHE BORING TOOL HOLDERS.

J. B. G., Cleveland, O., writes:

The lathe boring tool holder, Fig. 3, has been in use in the shop where I am connected, and has given very good satisfaction. It is a plain iron casting, tongued and fitted to the toolpost slide of the lathe in which it is intended to be used, and is clamped in position by inserting a piece of steel in the toolpost and secured as an ordinary tool would be clamped. The boring tool is clamped by two set-screws, and the heart-shaped holes for the tool not only accommodate different sized tools, but insure rigidity.

The holder is very efficient, and yet so simple that the illustration fully explains itself.

SIMPLE LATHE RIG.

Geo. W. Strombeck, Moline, Ill., writes:

In passing through a machine shop not long ago, I noticed a little device by means of which a number of tools could be held in position for alternate use on small lathe work. The work turned out in this particular instance was a kind of

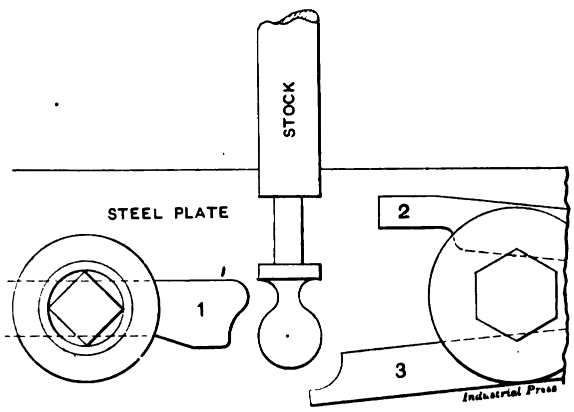


Fig. 4.

round-headed pin, adapted for stoppers in oil holes, etc., but the principle can, no doubt, be used with advantage on other small lathe work.

The accompanying illustrations, Figs. 4 and 5, are so plain as hardly to need any explanation. As can be seen, the rig is

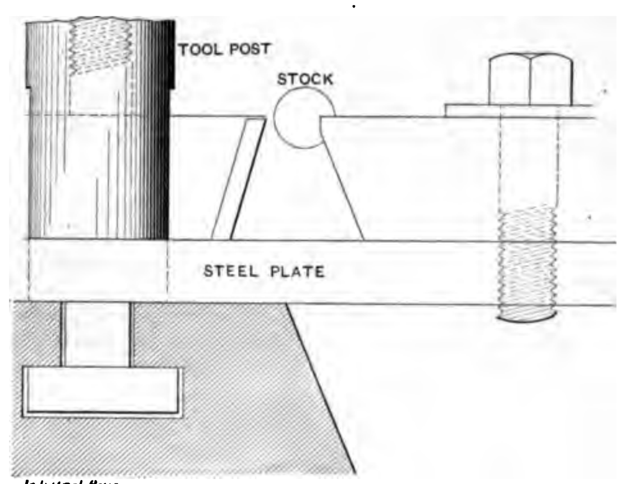


Fig. 5.

a steel plate clamped under the tool held in the tool post. On this plate the other tools (in this case two) are clamped. Tool 1 is used when the lathe-spindle turns forward, whereas 2 and 3 are used when it runs backward.

BORING SENSITIVE DRILL FRAMES.

James F. Willey, Jefferson, Ind., writes:

I send a sketch of a rig for boring the holes for the spindles and tables of sensitive drill frames, so that they will come in line. It consists of mounting the drill frames between the centers of a lathe and operating the boring bar in an attachment on the carriage of the lathe, as shown in the cut, Fig. 6. The boring bar is fitted in the casting *A*, which is bolted to the carriage, and it is driven through gears at *B* by the long-splined shaft *S*. The splined shaft is carried in a bearing *C*, fastened to the headstock, and it is driven by the small pulley *P*, belted to the cone pulley, the cone pulley being out of

gear with the spindle. The drill frame is swung around until the table support *D* is in line with the boring bar, and then the support is bored. Then the support is loosened on the frame and swung out of the way, and the boring bar moved up to sliding head *E*. The head is bored, and then removed, so that the boring bar may be moved up to the top of the column for boring and facing it at *H*. The carriage movement is utilized for feeding the boring bar when boring. In this way perfect alignment is secured throughout.

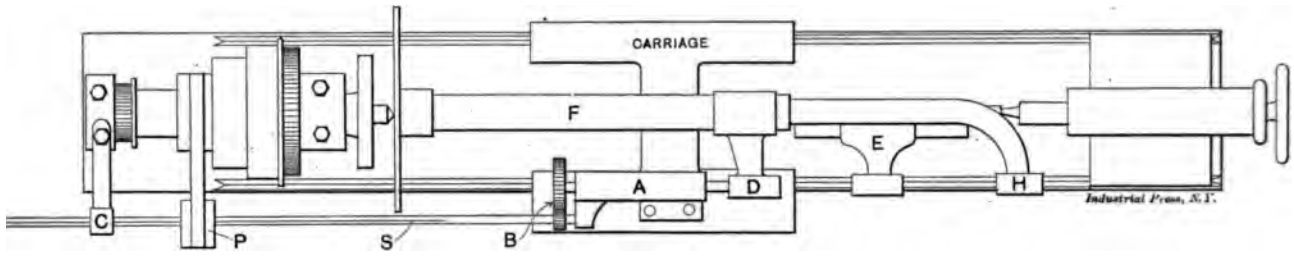


Fig. 6.

TWO METHODS OF MAKING PUNCHES.

W. L. sends the sketch herewith of two kinds of punches which he says have been used quite frequently in the punching presses in their factory and he has found by practice that the punch shown in Fig. 7 is far better than that illustrated in Fig. 8. This punch, Fig. 7, can be made from steel one-half the diameter of punch No. 2, which is quite a saving where many are to be used. It can be tempered more evenly, as the stock is more evenly cooled off in the hardening, and a variety of smaller sizes can be had by reducing the point, using the same sleeve for them all. This sleeve is tempered in oil so that it is very tough and prevents the punch from bending, whereas the other punch bends when left soft enough to prevent the point pulling off. W. L. states that they have used these punches on iron thicker in diameter than the punch, as in the case of punching holes for cold pressed nuts, and with these punches they have punched two tons of iron which work the other punch did not stand.

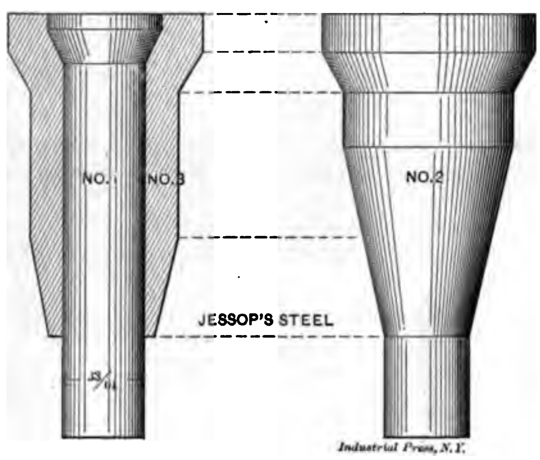


Fig. 7. Fig. 8.

WASHING OVERALLS.

"Nemo" writes: Machinists' overalls are the horror of every "washer lady" and most laundries do not fall in love with them. I once worked in a back country shop where the problem of clean overalls had been solved. In the cellar they had a machine built, as shown in Fig. 9. It consisted simply of a barrel with flanges bolted on opposite sides "amidships." These flanges were to hold short pieces of shafting, one of which was long enough to hold a pulley. The shafts were mounted in suitable bearings so the barrel could revolve, and one end of the barrel had an elliptical hole cut in it which was fitted with an ordinary boiler manhole plate and yoke about 9 x 12 inches.

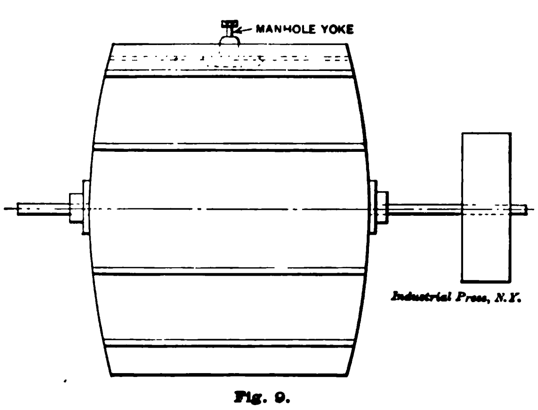


Fig. 9.

The overalls were put in through the hole with two or three pails of water, hot preferred, and a half a bar of soap or a liberal quantity of soap powder. Then the manhole plate was put in, the belt attached and the barrel was revolved at about 50 turns a minute for about two hours. The overalls were then removed and rinsed in clean water and hung up to dry. By this method the dirtiest overalls could be made as clean as when new.

BELT SHIFTER.

At the works of the Brown & Sharpe Mfg. Co., Providence, R. I., belt shifters are in general use for shifting the belts on the driving cones of the various machine tools. The sketch, Fig. 10, shows the principle of construction of the shifters as applied to an engine lathe. The vertical shifter rod has a bearing at the bottom in a bracket attached to the lathe bed, and at the top is supported by a cast-iron bracket attached to the ceiling. The top bracket is made in two pieces, the lower one of which can be swiveled upon the other for convenience in adjustment. At a point on the rod near the countershaft cone is attached a sleeve, free to turn, but not to slide on the rod, and through which slides the arm or rod carrying the belt shifter. The shifter acts on the side of the belt which approaches the pulley. In shifting the belt it must be thrown off the step on which it is running on the lower cone, with the hands, and it is changed on the upper cone, one way or the other, as desired, by the aid of the handle attached to the lower end of the vertical rod.

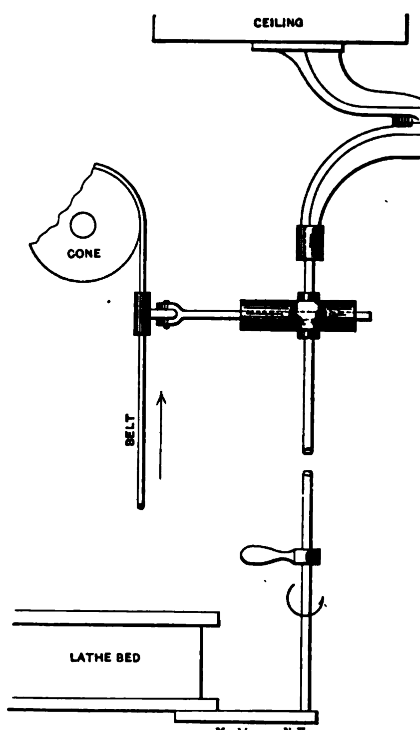


Fig. 10.

NEW DISK GRINDER.

A disk grinder of new design is shown in Fig. 4. It is manufactured by the Bayldon Machine & Tool Co., 18-20 Morris Street, Jersey City, N. J. It is a powerfully driven grinder, well built, and is sold at a moderate price. It is made in two sizes, with 18 and 23-inch disks, and will finish flat surfaces accurately and cheaply, square, parallel or at angle with one another. A special feature of the machine is the design of the spindle and bearings, which are shown in Fig. 5. The spindle is of a highgrade steel, accurately ground, the faceplate being ground on its face in position. The two sides of the plate are parallel, and the abrasive material may be attached to either. The journals are self-lining and lubricating 5 inches long, 1⅝ inches diameter, and have spirals cut from end to end. The pressure on the disk is taken by a ball thrust bearing. Two styles of tables are furnished, one of which does not move with the work, but is adjustable for height and distance from face of disk; the other has a rocking movement and also tilts, is counterweighted and can be raised or moved out or in from the disk. The machine is made either double or single, with disks on each end of the spindle or on one end only as desired.

Fig. 4. Bayldon Disk Grinder.

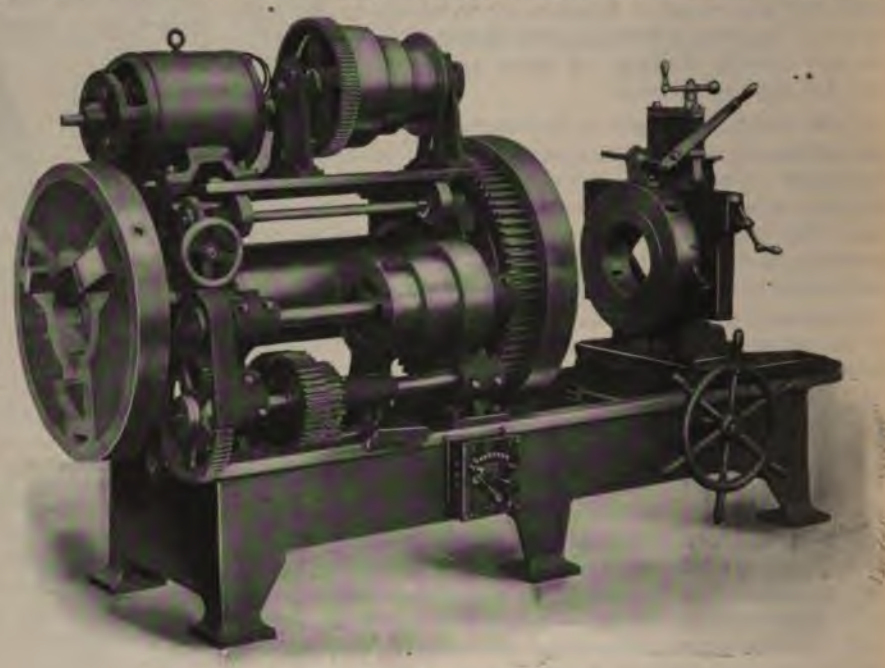


Fig. 6. Bignall & Keeler Electrically Driven Pipe Threading Machine.

APPLICATION OF ELECTRIC MOTOR.

The illustration, Fig. 6, shows the style of electric drive designed by the Bignall and Keeler Mfg. Co., Edwardsville, Ill., for their duplex pipe threading and cutting machines, which are made in sizes for pipe from 6 to 18 inches in diameter.

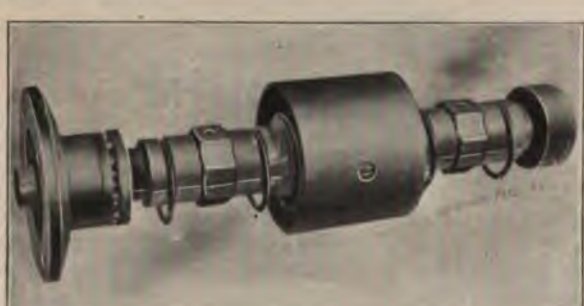


Fig. 5. Spindle and Bearings of Grinder.

It is well known that the method of controlling motor speeds by means of resistance boxes is wasteful and unsatisfactory. With the drive shown the motor runs at constant speed and the speed variation is obtained by cone pulleys and a shifting belt which is a satisfactory method where no multiple voltage or other special system is available. The motor is supported on a table directly over the main bearings of the machine, which also supports a countershaft on which a 3-step cone pulley and a large gear wheel are securely fastened. The motor pinion meshes directly into this gear on the countershaft. One side of the table is supported on a hinged bearing, fitting into one side of the main journal cap, while the other side is supported on two steel cams, as shown. The cam shaft is supported in journals, and the cams may be revolved and the table elevated or lowered by means of a worm and wormwheel. With this cam movement, the belt, which naturally grows loose through wear, can be tightened when necessary.

With three steps on the pulley and the sliding gear on one of the shafts, six separate speeds are obtained. The device for regulating the height of the table and thereby regulating the tension of the belt makes the short belt drive between the cone pulleys quite as effective as if a long belt were used. With this method of driving no increase in floor space is needed; the machine can be placed in practically any shop where belt machines are used, and being self-contained, can be easily moved from one locality to another.

A UNIQUE GRINDER.

In Fig. 7 appears a cut of an electrically-driven grinder which can be used for a wide range of work, such as lathe center grinding, reamer grinding, surface and internal grinding, and is limited only by the size of the lathe in which it is used. The tool is held in the tool post of the lathe by means of a steel shank *B*. This shank can be removed and

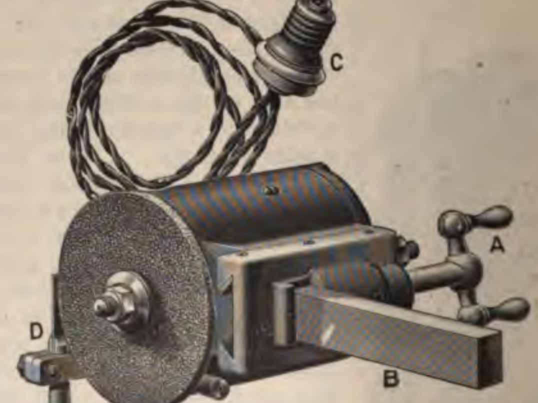


Fig. 7. Electrically Driven Grinder.

another of a different size substituted if desired. The grinding of cutters and reamers is accomplished by holding the work between the lathe centers and using the tooth rest attached to the grinder for indexing. Bevel cutters may be ground in a like manner, it being only necessary to adjust the motor to the desired angle. For center grinding the tooth

rest *D* is removed and the motor is placed at the angle of the center to be ground. The machine has a slide movement of two inches through the handle *A*, and the slides are fitted with a gib to take up the wear. The machine receives current for the motor from the incandescent light circuit of the shop and can be connected to any lamp socket. Internal grinding is accomplished by an extension mandrel furnished as an extra, and the machine will be found very handy for grinding hardened rings and collars. The motor is entirely encased, making it dust-proof, and the bearings are provided with dust-proof caps and are adjustable for wear. The machine is made by the Hisey Machine Works, 77 Elm St., Cincinnati, O.

NEW MACHINISTS' TOOLS.

The illustrations, Figs. 8 and 9, show two tools placed on the market by the Massachusetts Tool Co., Greenfield, Mass. The first of these is a 6-inch micrometer caliper designed for measuring from zero to 6 inches by half thousandths. The sliding micrometer head travels on a cylindrical barrel through which a hole is accurately bored to accommodate three plugs, one, two and three inches long, as in the engraving.

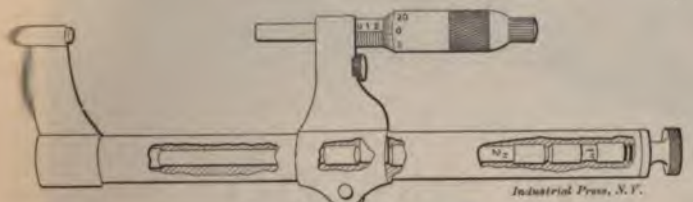


Fig. 8. Six-inch Micrometer.

These plugs serve to locate the traveling head at fixed distances one inch apart. The micrometer screw itself has a travel of one inch, like any standard micrometer. A locknut is used to hold the screw in any desired position. A thumb screw at the end of the barrel bears against the end plug and zero marks are provided to bring the screw against the plug with the same degree of pressure at each setting. When the head is clamped by means of the locking nut, it is as rigid as though it were solid with the barrel, and the faces of the measuring points are thus always parallel.

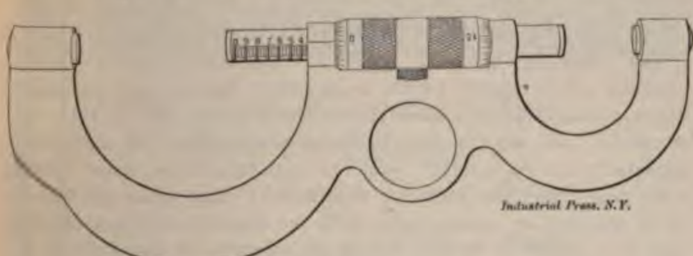


Fig. 9. Combined One and Two-inch Micrometer.

A combined one- and two-inch micrometer is shown in Fig. 9. One side records measurements up to one inch, and the other side up to two inches. A single knurled sleeve or nut serves to move the double-ended measuring piece one way or the other as desired, this piece having a travel of one inch. The spindle is non-rotating, so that the faces of the screw and anvil are always parallel. A locking device holds the screw in any position. This tool is convenient for use both in measuring and as a gage, since it can be conveniently held by the finger ring appearing at the back. A modification of the 6-inch micrometer is made in the form of a 6-inch micrometer surface gage which operates on the same principle.

HEAVY ARBOR PRESS.

A new arbor press has been brought out by Edwin E. Bartlett, Boston, Mass., manufacturer of the Greenerd arbor press, which is of radically different design from the smaller presses previously brought out. The new machine is to be known as the No. 8 Greenerd arbor press. It is powerfully geared with a leverage of 250 to 1, and it is anticipated that a pressure of between 15 and 18 tons will be realized at the end of the ram, with a man of ordinary strength at the lever. The ram is made of a piece of 4-inch crucible steel and has a rack cut on two opposite sides. The gears are all of steel, the smaller being of hardened tool steel. The gears were designed especially for this press by the Brown & Sharpe Mfg. Co. The fact that the force applied at the lever is transmitted to the ram by two sets of gears, one operating in the rack on one side of the ram and the other on the opposite side, gives a powerful and uniform pressure to the ram throughout its whole travel. When the lever is at its lowest position the pawl drops from the ratchet and the

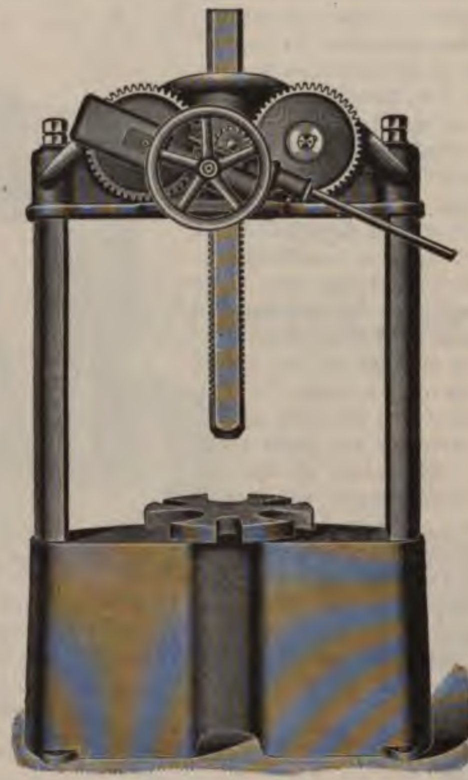


Fig. 10. Greenerd Arbor Press.

ram is free to be moved in either direction by means of the hand wheel shown in front. It will be noted that the sides of the ram are recessed at the ends of the rack teeth, so that the teeth do not bear on the slides in the frame of the machine, which might prove detrimental and cause excessive wear. The press weighs about 2,000 pounds, and is designed for driving arbors up to 7 inches in diameter. There is 36 inches clearance between the uprights, and 35 inches between the plate and the top of the frame.

UNIVERSAL DISK GRINDER.

The accompanying half tone, Fig. 11, illustrates the No. 15 ring universal grinding machine, brought out recently by the George Gorton Machine Co., Racine, Wis. This machine is

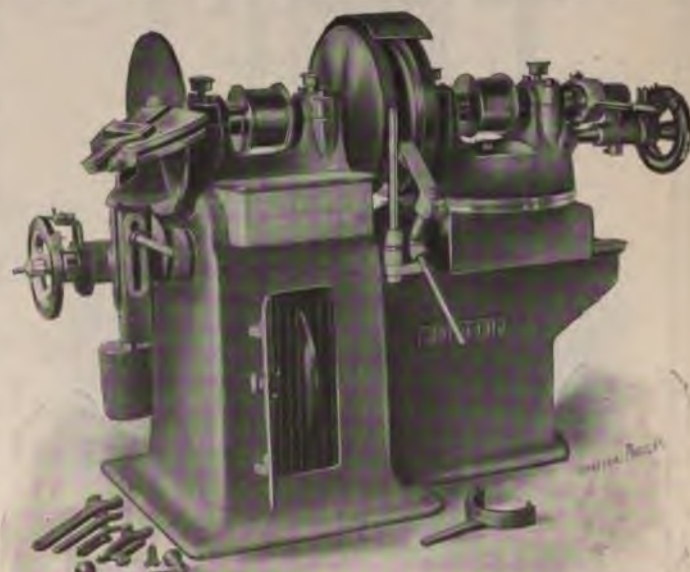


Fig. 11. Gorton Grinder.

equipped with a two-speed countershaft, the highest speed being utilized for operating the steel disks, one of which is shown on the arbor at the extreme left. The slower speed operates the two central chucks which contain 15-inch emery rings designed specially for the finishing from the rough. Two arbors carry the emery rings, and thus parallel surfaces may be produced accurately of interchangeable dimensions, these dimensions being retained by means of the micrometer stop contained at the extreme right of the machine, and adjusted by the handwheel shown, which is graduated in thousandths. The right-hand arbor has an endwise movement of one inch, and is moved to and from the work by the lever shown at the right hand. It is mounted upon a headstock adjustable 30 degrees each way. The swinging tables shown between the two chucks are for special work requiring the passage of the pieces between the emery rings. A diamond point is also provided on this table, for dressing the rings when necessary. The table at the extreme left has angular adjustment—micrometer, graduated in thousandths of an inch, and protractor, registering in degrees. The emery ring chucks open from 0 to 12 inches. These machines are also equipped with 18-inch steel disks throughout instead of the emery rings, for such work as the finishing of brass and for other work not requiring the removal of an excessive amount of scale. The machine complete weighs 3,000 pounds.

MULTIPLE SPINDLE DRILL.

During the past year Foote, Burt & Co., Cleveland, Ohio, have added to their various lines of multiple spindle drills, so that now they are able to furnish any type of multiple drill

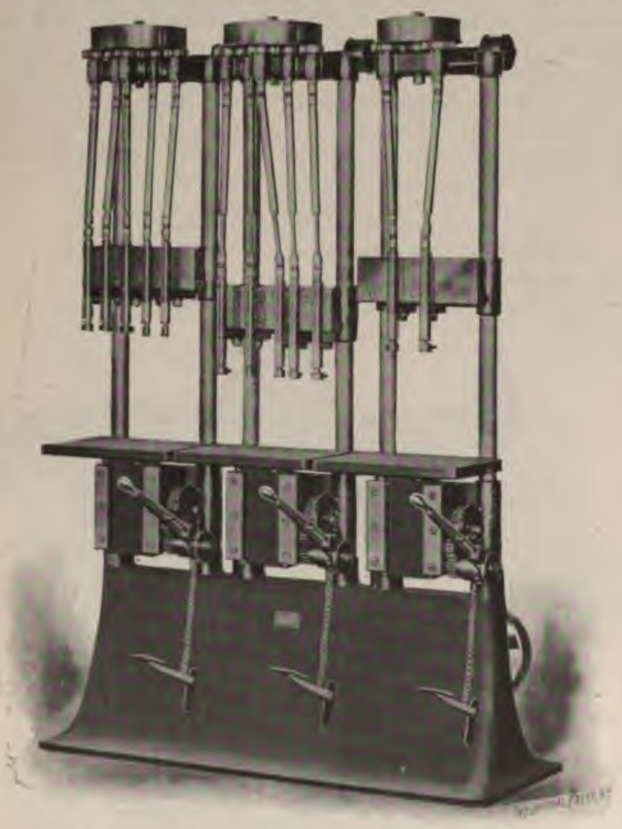


Fig. 12, Universally Adjustable Multiple Drill.

in almost any size that may be required for both light and heavy work. They manufacture a complete line of sensitive drills, having from two to six spindles and automatic feeds if desired. Their heavier drills have independent feeds for the spindles and will drill holes up to 1½ inch in diameter. In the accompanying illustration, Fig. 12, is one of several styles and sizes of drills having universally adjustable spindles, the machine shown having recently been placed on the

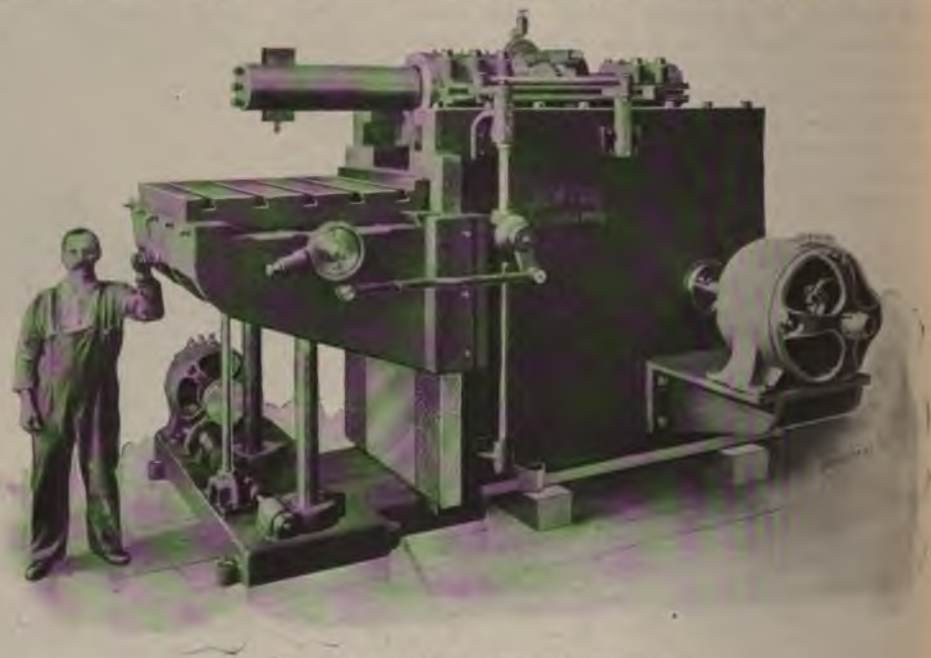


Fig. 13. Newton Shaper of Unusual Dimensions.

market. In this case there are really three independent machines mounted on one base, each group of spindles having from two to five spindles which may be adjusted either in or out from the drill, or longitudinally. This method of adjustment has the merit of great solidity, and by its use it is possible to procure any spacing of holes that may be required. The machine is provided with both treadle and lever feed, has a capacity of 5¼-inch drills in each group, and where less than five spindles are used correspondingly large drills can be employed. The larger machines with universally adjustable spindles will drill 1¼-inch holes.

HEAVY DRAW-CUT SHAPER.

The Newton Machine Tool Works, Philadelphia, have brought out a shaper which is so heavy and of such massive proportions as to be unusual even for a heavy tool of this description. It weighs about 30,000 pounds and is designed especially for such heavy work as cutting off the risers from steel castings. The machine stands very high from the floor, as is evident by comparison with the man in the engraving, and this allows a corresponding adjustment of the knee.

The design of the shaper is novel throughout. It is electrically driven, two motors being used, one for driving the ram and one for elevating the table and knee. The ram is driven by a Whitworth quick-return motion, and the speed reduction between the motor and this motion is by means of two worms and wormwheels, one worm and wormwheel driving the next pair. The Newton Machine Co. have made a specialty of this form of gearing, which insures its satisfactory operation even in an application of this kind. The shaper cuts during the return stroke, making it peculiarly adapted for heavy work. The body of the ram consists of a horizontal head or carriage sliding in ways, just as in the case of the ordinary shaper. Instead of supporting the tool, however, in a toolpost at the end of this carriage or ram, there is a cutter bar extending outward from the carriage for a considerable distance and the tool is supported at the end of this. One of the chief results gained by this construction is that no matter in what position the ram may be, its ability to resist any upward thrust at the cutting point will always be the same and hence the deflection of the bar will be uniform throughout the stroke. Theoretically, at least, more accurate work can be obtained in this way because with the usual design of ram the distance between the point of support of the ram and the cutting tool changes for every point of the stroke. So far as we know, however, this shaper is the first to be constructed

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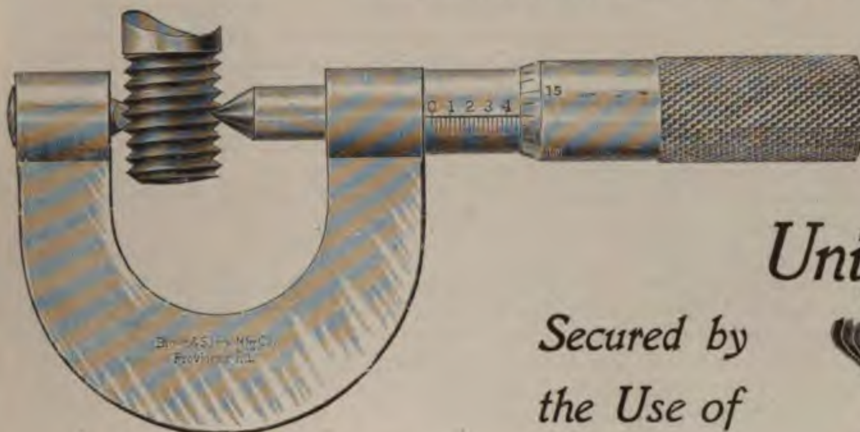

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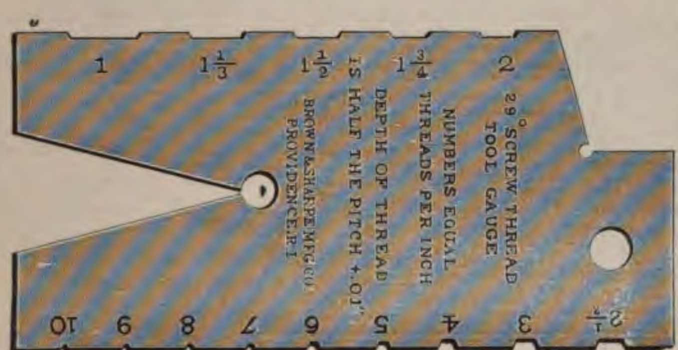

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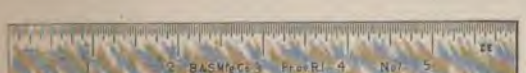

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on the principle explained above, although such construction has been advocated by a contributor in MACHINERY.

The cutter bar is 9 inches in diameter, which dimension gives an idea of its massiveness and power. The bar has a rotary feed by means of a worm and wormwheel operated by a ratchet movement, adapting the machine to shaping out the field pieces of electric motors and other circular work. This feed, as well as the other usual feeds with which the machine is provided, is automatic. The stroke of the cutter bar is 18 inches.

* * *

HISTORY OF THE COOKING RANGE.

Josiah M. Read, the inventor of a cooking range and a manufacturer of stoves, died at Boston, Mass., November 7, 1901, at the age of 92 years. Mr. Read began the manufacture of stoves in Boston in 1839, and invented his cooking range in 1846. It has been erroneously stated that he was the originator of the cooking stove or range, whereas he is, in all probability, only an improver of it. There appears to be no authentic record of who was the inventor of the portable air-tight stove for domestic use. Isaac Orr, who died in 1844 at the age of 50 years, is said to have been its inventor, but the claim is not well substantiated, and, in fact, is proved untrue by air-tight stoves built as early as 1767. The first cooking stoves were made by an adaptation of a baking oven to the box-stove, such as formerly generally used in schools, churches, etc. Such a cooking stove was made in 1812 at Hudson, N. Y., by a Mr. Hoxie, but it appears that he was not the originator of the idea, as subsequent litigation developed the fact that his patent claim was based on the firebox being above the oven, with a flue to carry the products of combustion downward around the oven. To Gordan L. Mott, of New York, belongs much credit for the development and improvement of stoves. He is said to have been one of the first to successfully use cupola or re-melted iron for stove plates. Previous to this stove plates were made from blast furnace iron, which is, of course, the same as pig iron, and they were consequently very rough and heavy. The reason for using such iron was that no one had been able to use re-melted iron successfully on account of the plates cracking from the heat. Mott used cupola iron and got thin, clean castings, which made what were then thought to be elegant stoves. To avoid cracking, the plates were paneled, fluted and curved, which allowed them to expand freely when heated, so that Mott's first success appears to have been more because of design of the plates than because of any radical improvement in the quality of the iron. His first patent on stoves was granted in 1832. Joel Rathbone, Albany, N. Y., was another pioneer in the stove industry, who probably did as much if not more than Mott for the improvement of iron founding. He successfully made light, thin stove castings from cupola iron in 1838. His stoves soon became popular because of their lightness and cheapness, and the business of stove making within a few years grew to great proportions. Bearing on the history of stoves and stove manufacture, the following item, which has appeared recently in a number of publications, is of interest: "A stove is owned by the Michigan Stove Co. which was made in 1767. It is described as an old-fashioned box stove, standing upon legs or end braces similar to those of a sewing machine, only that they are about half as high as the latter and are of much heavier casting. The total weight of the stove is 500 pounds, and the iron from which it is made is seven-eighths of an inch thick in all parts. It is 3 feet long, 34 inches high, and one foot wide, with a hearth extending in front. The only opening on top is a small hole for the pipe. It was evidently used for heating and cooking, although without lids. The oven would hardly accommodate a turkey, even of modest dimensions. It measures 14½ inches in length, 12 inches in width, and 6 in height. The floor of the oven is removable, thus making greater heating capacity. There is no grate in the bottom, the fire being built directly on the bottom of the stove, the heat passing from below the oven, back of it and over the top to the pipe. The outside has scroll designs and crowns in relief, much after the fashion of stoves to-day, and on both sides cast with the metal are the words: 'Hereford Furnace, Thomas Maybury, Manufacturer, 1767.' The stove is well preserved in spite of its almost 150 years of age. Thomas Maybury was a pioneer iron manufacturer in Pennsylvania and New Jersey in the 18th century. Hereford Furnace was one of his enterprises. It was located in the Schuylkill Valley, Pennsylvania, and was in existence and active as late as 1788. Mr. Maybury was himself a man of much prominence."

* * *

Reuleaux defines a machine as a combination of resistant bodies so arranged that by their means the mechanical forces of nature can be compelled to do work accompanied by certain determinate motions; and a machine tool, as a "form-changing" machine. The latter definition does not appear quite complete in view of common acceptance of the term "machine tool" since a wood planer is a "form-changing" machine, but certainly it is not a machine tool. A more complete definition might be: "A machine tool is a form-changing machine for working metals."

* * *

We are informed by the Blair Machine Tool Works, 24-27 West St., New York, that the fixture for milling lag screw threads described in the last number of MACHINERY was designed by their superintendent, Mr. J. A. Webster. We are glad to give credit for the design, as the device was of unusual interest and showed much originality in its design.

* * *

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

THE TURNER, VAUGHN & TAYLOR CO., Cuyahoga Falls, O. Catalogue of chain machinery which includes the new Edgecombe hammer that has recently been placed on the market.

THE B. F. STURTEVANT CO., Boston, Mass. Illustrated circular of the Sturtevant forges, including the down-draft forge with adjustable hood. Forges for both heavy and small work are shown.

THE F. E. REED CO., Worcester, Mass. 1902 catalogue of engine lathes, speed lathes, chucking lathes, etc. The lathes made by this company are too well known to need further mention. A new machine illustrated in this catalogue is a rack cutter, which is semi-automatic in its operation. A spindle drilling lathe is also shown.

THE GOODELL-PRATT CO., Greenfield, Mass. Catalogue No. 5 of small tools for machinists, carpenters and others. This company make a great variety of automatic hand and breast drills, for drilling metal and wood and automatic screw drivers. They also make several styles of bench drills, for amateur and machinists' use. Their list of tools includes also their hack saws, polishing heads, belt clamps, etc.

THE MASSACHUSETTS TOOL CO., Greenfield, Mass. Illustrated catalogue of machinists' tools and small model bench lathes. The tools listed include a line of micrometer calipers and several special calipers for inside and outside measuring, two of which are illustrated in another part of this issue. There are also surface gages, protractors, trammels and other tools. This company have purchased the mechanical tool business of Coffin & Leighton, Syracuse, N. Y., and will continue the manufacture of scales which this latter company formerly made.

THE CINCINNATI PLANER CO., Cincinnati, O. Catalogue of the standard line of planers made by this company. These are made in sizes ranging from 24 to 60 inches. They include both belt and electrically driven machines, the latter having the motor mounted on top of the housings, from which point power is transmitted by belts to the pulleys at the base of the machines. There are also shown widened planers, which have the uprights further apart in proportion to the height than the standard machines, and the bed is also widened on each side a corresponding amount. This is to accommodate work where extreme height is not required.

MANUFACTURERS' NOTES.

THE BALL BEARING CO., Boston, Mass., have sold out to Manning, Maxwell & Moore, but will continue to do business under the old name.

THE BURT MFG. CO., Akron, Ohio, have recently received an order from the De Beers Consolidated Mining Co., Ltd., of Kimberley, South Africa, for a very large Cross oil filter to be used in their new power house.

THE business formerly carried on by Perry Ransom, Oshkosh, Wis., has just been purchased by the Ransom Mfg. Co., with capital stock of $25,000. The new company will carry on business on about the same lines as heretofore.

M. A. HUDSON and H. S. Whitney, formerly connected with one of the largest machinery supply houses in New York, are representing in New York and vicinity the Standard Gage Mfg. Co., Syracuse, N. Y.; J. E. Lonergan & Co., Philadelphia, Pa., and the Penberthy Injector Co., Detroit, Mich. They have offices at 141 Broadway.

THE BICKFORD DRILL & TOOL CO., Cincinnati, O., have recently added to their plant a three-story building on the corner of Pike and Front Sts., to be used for their general offices, drafting rooms pattern shop, and also as a show room for their tools. The room which this addition releases in the main works is badly needed for manufacturing purposes.

THE REEVES PULLEY CO., Columbus, Ind., manufacturers of the "Reeves" variable speed transmission, report a healthy condition of trade in this branch of their factory, the large number of orders recently booked making it necessary to operate this department 13 to 14 hours per day. The paper industry has opened up an unlimited field for the application of the larger sizes, and for the handling of these massive machines the company have built quite an extensive addition to their works.

THE R. A. KELLY CO., Xenia, O., manufacturers of shapers, have bought the large plant of the National Cordage Co., which adjoins their own, and will use the main building for the manufacture of shapers and the remainder for a needed addition to their cordage works. The machine shop has been located some distance from their main works, and a considerable saving of time and expense will be effected by this purchase, as well as additional room secured for the lack of which their shaper business has been suffering.

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MACHINERY

VOL. 8. FEBRUARY, 1902. No. 6.

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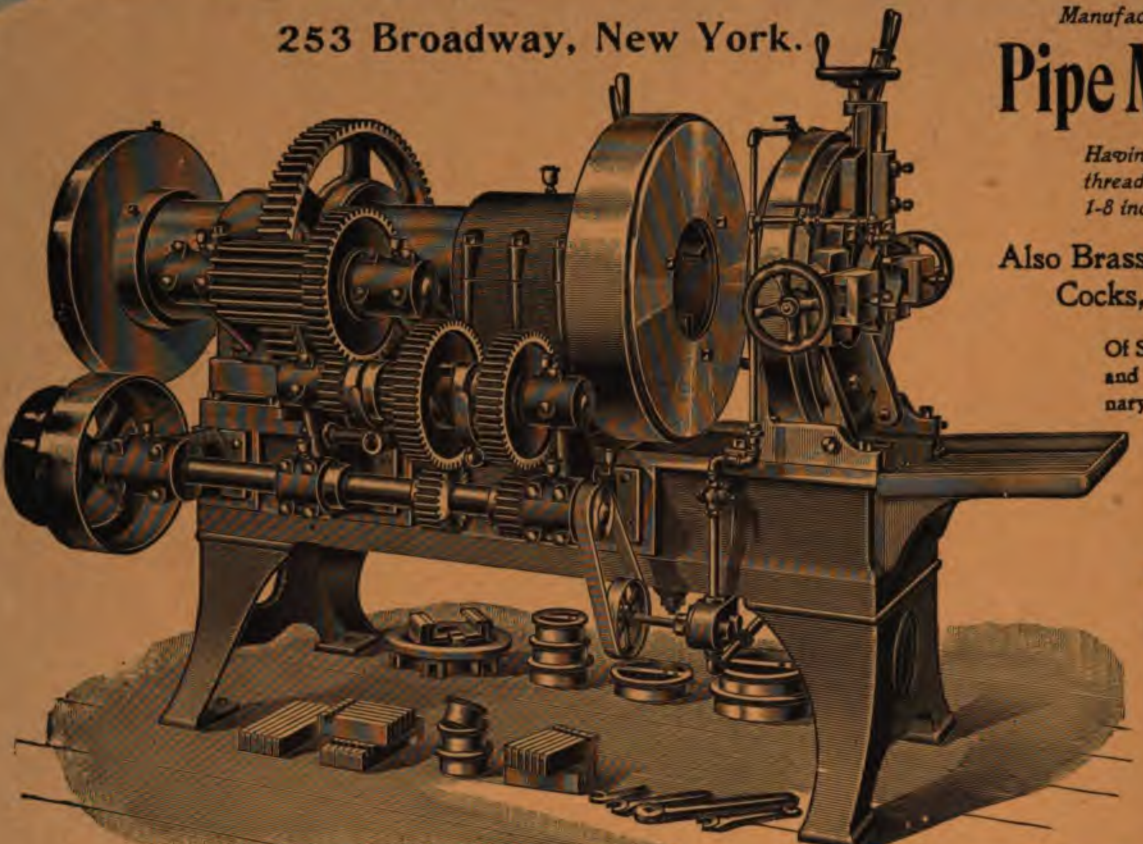

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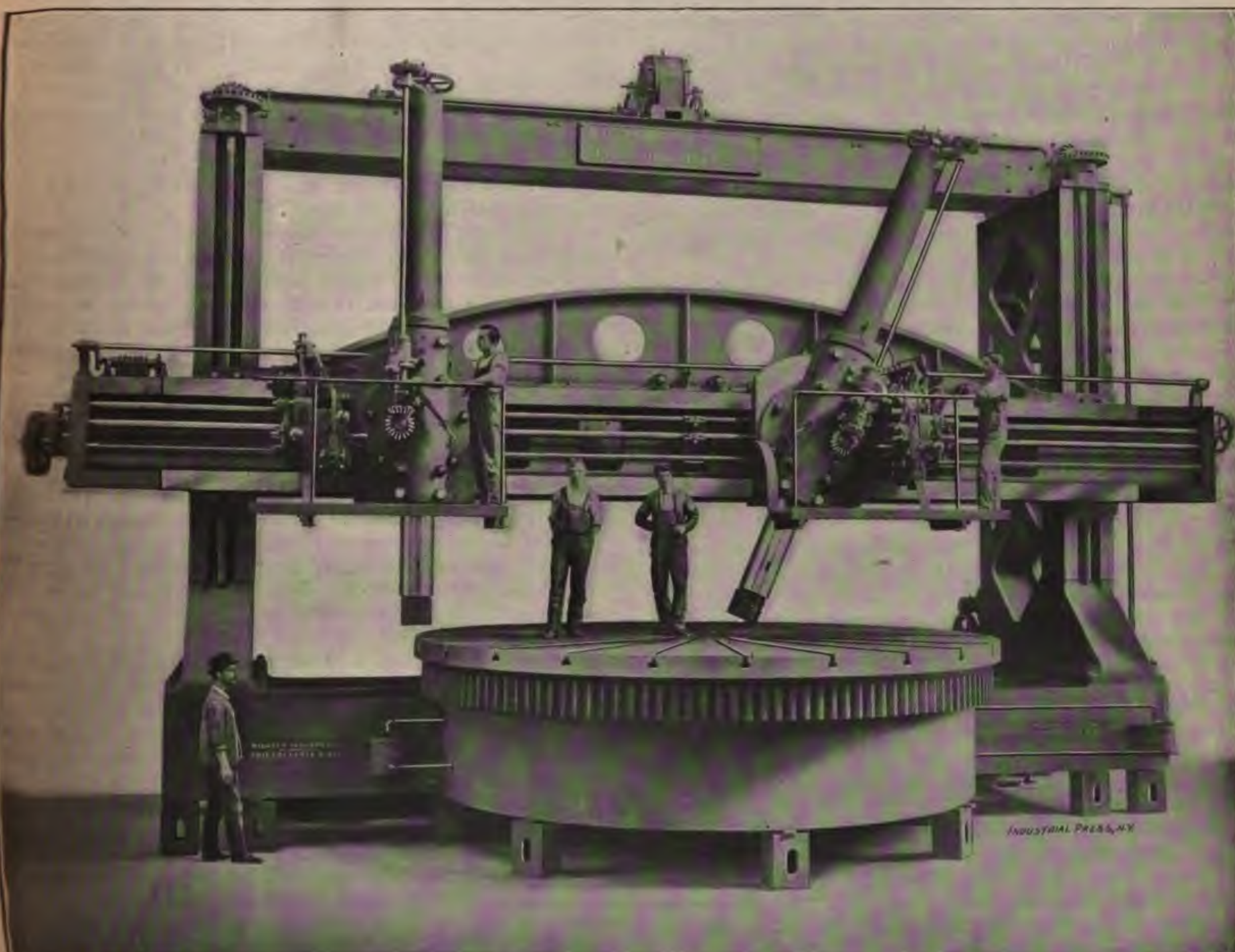
MACHINERY.

Vol. 8. February, 1902. No. 6.

A NOTABLE BORING AND TURNING MILL.

Something over a year ago William Sellers & Co., Inc., Philadelphia, installed two 28-foot boring and turning mills in Pittsburg, one at the shops of the Westinghouse Electric and Manufacturing Co., and the other at the works of the Westinghouse Machine Co. We have already alluded to these boring and turning mills and have shown illustrations of each of them as they now appear, in connection with articles upon the above plants. Through the courtesy of William Sellers & Co., Inc., we are now able to give further particulars about these remarkable machines and to publish a reproduction from a photograph of one of the mills, taken before it was shipped from the Sellers shops.



Twenty-eight Foot Boring and Turning Mill Built by William Sellers & Co., Inc., Philadelphia.

The capacity of these machines is very great and in points of strength, massiveness and power they probably surpass any boring and turning mills that have ever been constructed. Boring and turning mills for very large work are usually so constructed that the housings may be moved back, away from the center line of the table, to admit the largest diameters of work. Such machines are primarily designed for the smaller work, but upon occasion can be employed for larger work, though at a disadvantage.

In the Sellers mill the housings are not adjustable but the machine as it stands is large enough to admit work 28 feet in diameter. The only mill in the country of larger capacity is one at the Union Iron Works, San Francisco, Cal. This will admit work 30 feet in diameter without the need of moving the housings, but it is of special design, with somewhat limited capacity, and is less massive and powerful than the Sellers machines.

In any boring and turning mill the crossrail must not only resist the direct thrusts of the cutting tools, but must be able to withstand the torsional stresses when the boring bars are extended for deep boring and turning. It is customary to make a crossrail very deep at the center, but thin at the ends where attached to the housings and it is hollowed out in a trough-like form to afford room for the screws and feed rods. The resulting section is not well adapted to withstand torsional strains and no amount of "back swell" in the center of the beam will increase the torsional strength at the weakest section, although of importance in resisting the horizontal forces.

In the 28-foot Sellers boring and turning mill the crossrail has been designed with special reference to the torsional strains, which at times must be very great. The housings are of rectangular section, the front and back edges being parallel and the crossrail is extended back to the rear face of the housings where an additional pair of elevating screws and clamping shoes are provided. The crosshead

bar measures 7 feet 6 inches from the front face of the housings to the clamping point on the rear, while the depth is 40 inches. When this great beam, braced by internal diagonal webs, is secured by the front and back to the housings, the device affords a degree of rigidity hitherto not obtained in machines of this character. The front of the crosshead is further stiffened by a curved beam over 43 inches deep in the middle and bolted to the top of the crossrail between suitable cast abutments.

When the crossrail is clamped up for work, it is so thoroughly braced to the two housings that no connection would be needed between them at the upper ends were it not that a support is required to carry the elevating machinery. This support is provided in two 20-inch I-beams, which carry the electric motor used for raising and lowering the crossrail, as well as the necessary shafts, wheels and bearings.

Two saddles are provided, each carrying a 12-inch boring bar of 7 foot stroke. Attached to each of the saddles there is a convenient platform for the operator, and from this position he can control all the movements of the saddle and boring bar. The feed screw for horizontal adjustment is stationary and both saddles have nuts engaging with the screw. Each saddle carries its own feeding mechanism, with change wheels for altering the speeds of feed, and there are within the crossrail two shafts from which power may be taken. The first, which is used for regular feeds, is driven by the driving gear of the boring and turning mill, and runs at a constant speed in relation to the table, while the other shaft is operated by a motor on the back of one of the overhanging ends of the crossrail, which may be stopped and started from either saddle and is used to drive the rapid traverse mechanism. The saddles can be moved along the crossrail or the bar raised or lowered by rapid power traverse, and with great nicety.

The operating levers are so interlocked that the rapid traverse cannot be thrown in for one saddle unless it is disengaged from the other, so that it is impossible for the operator on one head to move the opposite head accidentally. Convenient levers are arranged for throwing in the various movements, so that the operator has perfect control of the movements of the boring bars in every direction.

The vertical feed is accomplished by the heavy screw passing within the boring bar, and is sufficiently powerful to enable the bar to be used for slotting large keyseats where desired.

The great length of the crossrail, nearly 39 feet, makes it necessary to provide intermediate bearings and ingenious drop hangers are provided which will move out of the way as the saddles travel along the rail, but when in action they hold the shafts effectively in closed bearings.

The table is 18 feet 4 inches in diameter and is provided with external spur gearing, protected by an overhanging edge, and is carried on two wide flat annular bearings, and centered by a spindle 25 inches in diameter in a bearing adjustable for wear. The table gear is 4⅝ inch pitch, 11 inch face, and the driving pinion is on the vertical shaft at the rear of the machine.

To insure a thorough lubrication of all the table bearings, a centrifugal force pump is provided which delivers the oil to the vital points, and the overflow is collected, passed through filters and returned to the pump tank by gravity. This system has proved eminently satisfactory in practice, and the lubrication has been all that could be desired.

Two changes of gearing are provided and in the machine shown the drive is directly from an electric motor (20 H. P.) through a Reeves variable speed countershaft.

* * *

The average work of a laboring man is considered to be 2,000,000 foot pounds per day, but this work has been enormously exceeded in individual cases, especially in that of certain long distance bicycle riders. In an article, "The Efficiency of the Bicycle Rider as a Machine," by R. C. Carpenter, published in the *Sibley Journal*, it is shown that the work done in long distance bicycle races has amounted to as much as 15,000,000 foot pounds for one day and 10,000,000 foot pounds average for five days.

SUCCESS IN HARDENING STEEL.

PRACTICAL SUGGESTIONS ABOUT THE FIRE, THE STEEL AND THE METHOD OF TREATMENT.

E. R. Markham.

Every shop has one or more men who are considered authorities on this subject. In many cases the man is really an expert, is careful, and uses good judgment in heating the steel and in quenching in the bath; and if the piece is of sufficient size, is sure to take the strains out by reheating directly after taking from the bath. In some cases that have come to the writer's notice, however, the success of an operator was measured by the failure of others, or by the fact that the party was willing to take risks. You cannot scare him with a little thing like a piece of steel. Then if the work passes through the fiery ordeal with enough of it left intact to do the work it is considered a *successful operation;* if not, the fault *must* be in the steel.

I have in mind a manufacturing concern who changed the brand of tool steel they were using three times in less than a year, because the man doing the hardening reported adversely on each make, after attempting to harden it. The article furnished was from three of the leading makers of tool steel. After receiving repeated complaints in regard to the man's inability to harden the steel successfully, one of the makers advised the manufacturers to let some expert in hardening try the steel. Some milling machine cutters were made from each brand of the rejected article, exactly like those they had attempted to harden. Every one came back all right, hard enough, not a tooth missing or a crack anywhere, proving the trouble was not in the steel.

One often hears in machine shops: "If we could only get as good steel as we had twenty-five or more years ago, there would not be so much trouble coming from the blacksmith shop." But the tool steel furnished by the leading makers of to-day is better for the particular purpose for which it is intended than most of the steels of the past. The reason people experience so much trouble in the manipulation of steel are manifold. First, many manufacturers consider only the first cost of the article, not realizing that fifty dollars worth of labor may be put onto twenty-five cents worth of stock, which, when hardened, may be, to say the least, highly unsatisfactory. I do not think it necessary to pay seventy-five cents a pound for steel, when the fifteen-cent article would be all right; neither do I think it good policy to buy a seven-cent steel when a better grade is needed. In other words, it is not advisable to waste dollars trying to save cents, as is the case when steel is bought that is not adapted to the purpose.

An expensive steel is not necessarily a satisfactory investment, and a "cheap" brand may be *very expensive*. It is necessary to understand just what is needed in a steel for a given purpose. Some makers have different grades of steel for different purposes—one for taps and similar tools, another for milling machine cutters, etc.—while others put out a steel that is very satisfactory for most purposes. Each has a good argument in favor of his particular method of manufacture.

In some shops it is thought advisable to use a grade of steel adapted to each individual class of tool; while in other shops, where detail is not followed as closely, this would cause no end of confusion. That part of the subject must be left to the judgment of the individual shop. But the treatment of the steel in the fire and the bath, in order to be successful, must be along certain lines. The successful hardener is he who finds out what particular quality is needed in the piece he is to harden; whether extreme hardness, toughness, elasticity, or a combination of two of these qualities. Then he must know the method to use in order to produce the desired result. The shape of the piece, the nature of the steel, the use to be made of the article, must all be taken into consideration. He must also be governed somewhat by the kind of fire he is to use.

Some brands of steel will not stand, without injury, the range of heat that others will; some require more heat than others in order to harden at all. When hardening, no steel should be heated hotter than is necessary to produce the de-

sired result. With some brands that give off their surface carbon very readily it is not advisable to heat them in an open fire, exposed to the action of the blast and outside air, as the products of combustion extract the carbon to such an extent that the surface will be soft even when the interior is extremely hard. While this might not materially affect a tool that was to be ground, it would spoil a tap, a formed mill, or similar article, whose outside surface could not be removed. In hardening anything of this nature in an open fire, it should be placed in a piece of tube or some receptacle, so the fire cannot come in contact with it while heating. There are a number of gas and gasolene hardening furnaces made which have a muffler to receive the work. The fire circulates around the muffler, but does not come in contact with the steel. Very excellent results may be obtained when one of these furnaces is used. The front can be closed by means of a door usually furnished, thus keeping all outside air away from the work. It will be found a great advantage if several large holes are drilled in the door, these being covered with isinglass, to enable the operator to see the work without removing the door.

Taking carbon from the steel is not the only injury done to a high grade of steel when heated in an ordinary blacksmith's forge by a careless operator. Most inexperienced men are apt to use a small fire, particularly if they find one ready built. It may be mostly burned out, but the operator will not care to take the time to get fresh coal, and get the fire to the proper heat; so he puts on the blast and endeavors to heat the work by means of a dead fire and plenty of *wind*. After a time the piece has all manner of heats, ranging from a low red to a white heat. He thinks it *averages* well, so dips it in the bath. If it comes out in one piece he feels lucky. If it does not have more than two or three cracks, and these where they will do *no harm*, his reputation as a hardener of steel is made.

Heating in a small fire is dangerous business, as the work not only comes in contact with the surrounding air, but with the cold air from the blast, which will cause minute surface cracks, making the steel look as though full of hairs. It will also fill the steel with "strains," causing ends of projections to crack and drop off in the bath.

If obliged to use the blacksmith's forge, have plenty of good charcoal. Make a large, high fire if the piece to be hardened is of any size; keep it up well from the blast inlet, using only blast enough to keep the fire lively, and bring the piece to the proper heat, burying it well in the fire to keep from the air. The lowest heat that will give the desired result should be used. This varies in different makes of steel, and must also be varied somewhat according to size and shape of the work. The teeth of a milling machine cutter will harden at a lower heat than a solid piece of the same size made from the same bar. Most steelmakers in their instructions say to harden at a low cherry red. To the average man this is a very uncertain degree; his cherries may be of a different hue from some other fellow's. My experience has taught me that most of the leading brands of tool steel in small sizes give the best results when hardened just after the black has disappeared from the center of the piece, provided we were heating slowly so as to get a uniform heat. In no case should steel be dipped when there is a trace of black in it.

The higher a piece of steel is heated—to a certain degree—the harder it will be; but if it is heated higher than is necessary the grain is opened, making it coarse and brittle, and it will be very liable to flake off under strain. For this reason, in the case of cutting tools, it is best to harden at as low a heat as possible. If the work gets too hot, yet not to a point where it is burned, it is always best to allow it to cool until the red has entirely disappeared, then to reheat to the proper degree and harden, and the grain will be fine. But if allowed to cool to the proper hardening heat and dipped, it would be as coarse as if hardened at the high heat, and would also be very liable to crack.

In hardening much more depends on the annealing than people in general know of. So much, in fact, that it is as necessary to understand doing it properly as it is to know how to harden aright. As generally understood, the office of annealing is to soften the steel, which is all right, so far as the party is concerned who works it to shape; but its relation to hardening is another matter. It removes all strains in the steel, incident to rolling and hammering in the steel mill and forging in the blacksmith shop. Experience teaches the hardener that it is necessary to anneal any odd-shaped piece or one with a hole or impression in it, after it has been blocked out somewhere near to shape, a hole somewhat smaller than finish size being drilled in it, and all surface scale being removed. The most satisfactory method to pursue is to pack in an iron box with granulated charcoal, not allowing any of the pieces to come within one inch of the box at any point. It should then be placed in the furnace and kept at a bright red heat for a length of time, dependent on the size of the steel. Pieces one inch in diameter should be kept at a red heat for one hour after the box is heated through; larger pieces should be kept hot correspondingly longer, allowing the work to cool off as slowly as possible. An annealing heat should be higher than a heat for hardening the same piece. Experience has taught me that the proper heat for annealing, in order that all strains may be overcome, should be nearly as high as for forging the same piece; in other words, it should be heated to a bright red and kept there long enough to overcome any strain or tension liable to manifest itself when the piece is hardened. Never pack tool steel for annealing in cast-iron chips or dust, as this extracts the carbon to such an extent that there will be trouble when hardening is attempted. Packing too near the walls of the annealing box will have the same effect to a less extent, but will be more troublesome, as the carbon will be extracted from the surfaces nearest the box, and not affected anywhere else, making the hardening very uneven.

If not situated so the above method can be used, very satisfactory results may be obtained by heating in a large charcoal fire to a uniform forging heat. Put two or three inches of ashes in the bottom of an iron box; on this place a piece of soft wood board, put the work on it, cover with another piece of board, and fill the box with ashes. The boards will char and smolder, keeping the work hot for a long time. Some blacksmiths use a box of cold ashes, while others use cold lime; either way is liable to chill the piece, making it harder than if allowed to cool in the air, and if either material is used it should be hot to get good results. Excellent results may be obtained by heating in a muffler oven, as a very uniform heat of any degree may thus be obtained. It can be run any length of time, but when a piece is heated through in this way it takes a long time to cool.

Hardening a piece of steel is generally accomplished by heating to a low red, and plunging in some cooling bath. As so much depends on the bath it is quite necessary to understand the effects of the use of the different kinds. The one most commonly used is clear cold water, though many use salt and water or brine. For hardening small articles that must be extremely hard, the following will be found very satisfactory: One pound citric acid crystals dissolved in one gallon of water. For very thin articles a bath of oil is necessary. For hardening springs, sperm is very satisfactory; when hardening cutting tools, raw linseed oil is excellent. There are hundreds of formulas for hardening compounds, some of which are excellent for certain classes of work. Some hardening solutions are poisonous, and are dangerous to have around; but for ordinary work the ones mentioned are sufficient.

Many successful hardeners use water that has been boiled, claiming better results from its use than from fresh water, which is liable to steam; and this steam, when formed, has a tendency to blow the water from the work, leaving it soft. Small odd-shaped pieces are not so liable to crack nor to harden unevenly when the water is slightly warmed.

We will now consider a few pieces of work to be hardened by the open-fire method. If we have a muffler furnace, so much the better, as with this it is easier to get certain results; but with care very satisfactory work can be done when the blacksmith forge is used. If it is a small tap, reamer, counterbore, or similar article we are to harden, it

is best to heat in a tube, bring to a low red, plunge in slightly warm water, or in the citric acid solution. If it is a hollow mill, with a hole running part way through it, we should dip it in the bath with the hole up, or the steam will keep the water from entering the hole, leaving the inside walls soft. The steam would also have a tendency to crack the piece; but with the hole up when dipping, by working the piece up and down well in the bath, the steam can escape, and the water can get at the work. Much bother may be saved the hardener if attention is paid to the steam likely to be generated, providing some way to prevent its keeping the water from the work. Brine does not steam as readily as clear water; neither do the different acid solutions used by many.

In hardening a milling machine cutter it is best to have a large, high fire, to bury the cutter well in the fire, and to use only blast enough to bring the work to the required heat, which should be uniform throughout. If the piece has not been annealed after drilling a hole through it, remove it from the fire when red hot, then allow it to cool off slowly until the red has entirely disappeared, when it can be again placed in the fire, slowly brought to the required heat, plunged in the bath of tepid water or brine and worked around well until it stops "singing." At this point it should be removed and instantly plunged in the oil bath, and left there until it is cool, when the strain should be removed by holding over the fire until it is warm enough to snap when touched with the moistened finger. It can then be laid aside, and the temper drawn at leisure. In hardening punch press dies we can treat them the same; if there are any screw holes for stripper or guide screws they should be plugged with fire clay or graphite. Much depends on an even uniform heat; uneven heats cause more tools to crack than high heats, although steel should not be given any more heat than is necessary.

Metal slitting saws can be hardened nicely between iron plates whose surfaces are kept oiled. The saws should be heated in such a manner that the fire does not come in contact with them. It is best to heat on a flat plate, as the tendency to warp is much less than if laid on an uneven surface. When the saw is properly heated, place on the lower oiled plate, placing the other one on it as quickly as possible; hold down hard until the saw is cool. If there are many such pieces to do, a fixture can be made so that one man can handle the saws and fixture alone; otherwise it takes two.

If there is no other means of drawing temper, brighten and draw by color; but, if possible, do it in a kettle or crucible of oil over the fire, gaging the heat by a thermometer. Much more satisfactory results can be obtained by this latter method; and if very many pieces are to be done, it will be found much cheaper. A very light yellow is 430 degrees; a straw color is 460 degrees; a brown yellow, 500 degrees; a light purple, 530 degrees. A milling machine cutter for ordinary work should be drawn to 430 degrees; a punch press die to 500 degrees; the punch to 530 degrees, and metal slitting saws to 530 degrees.

So much depends on the judgment and carefulness of the operator that men in charge of manufacturing plants should use great care in selecting a hardener, on whom depends the condition of the tools. The cost account may be increased or reduced materially by him. One cutter hardened and tempered properly will do many times the amount of work of one improperly done, to say nothing of the expense saved in grinding and setting machine, etc. As to the grade of steel to use, most of the leading brands of tool steel will give good results if properly handled.

* * *

While gasoline engines are common enough, gasoline locomotives are somewhat of a novelty. They are made, however, and are used mostly for mining purposes. The Prouty gasoline locomotive, recently illustrated in the *Mining and Scientific Press*, San Francisco, is built in sizes to haul from 15 to 100 tons, some sizes being designed to run on tracks as narrow as 18-inch gage. They have the advantage of steam locomotives for tramways in that there is no smoke and they are more easily managed. As in gasoline automobiles, the engine runs continuously in one direction and the speed variation and reversal are obtained through intermediate mechanism.

GEARING.—1.

CALCULATIONS CONNECTED WITH THE DESIGN OF (WHEELS—VELOCITY RATIO—SIZING THE BLANK

C. F. BLAKE.

Several years ago, through no fault of my own, I was y so young indeed that upon giving the blueprint boy a tion the chief draftsman put me in his place, and handi a copy of Brown & Sharpe on gearing, said, "You can your spare time profitably in studying this." Since tha I have noticed there exists some inseparable tie betwee drafting room apprentice and gearing. As soon as th has learned to draw circles with a compass and straight with a ruling pen he looks round for something to drav

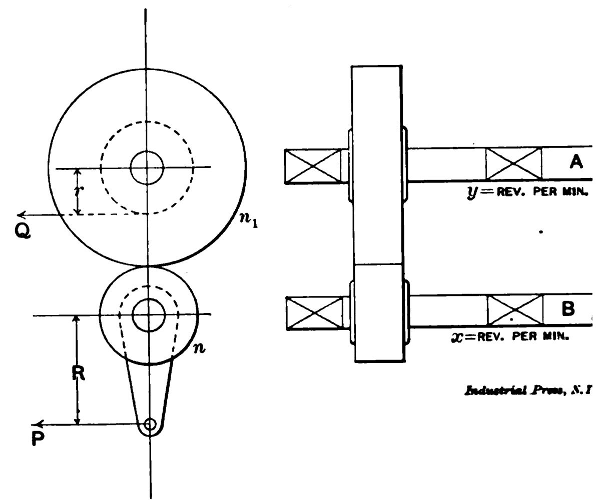


Fig. 1.

usually hitting upon a gear asks to be shown how to the teeth. As Grant says in his treatise upon this sub gear "is one of the most interesting objects in the fi scientific research, and not the simplest one;" althoug actual calculations required for the design of a pair of according to the usual shop practice are few and s It is to put these calculations into easily-understood that the present article is undertaken, there being littl or original to be said, although some of the tables it lieved have not before been published.

Table I.

Number of Teeth.	Constant K.	Number of Teeth.	Constant K.	Number of Teeth.	Co
12	.258	31	.102	52	.
13	.239	32	.097	54	.
14	.222	33	.094	56	.
15	.207	34	.093	58	.
16	.195	35	.089	60	.
17	.184	36	.087	62	.
18	.173	37	.084	64	.
19	.165	38	.082	66	.
20	.156	39	.080	68	.
21	.148	40	.078	70	.
22	.141	41	.076	75	.
23	.136	42	.075	80	.
24	.130	43	.073	85	.
25	.125	44	.071	90	.
26	.120	45	.069	95	.
27	.115	46	.067	100	.
28	.112	47	.066	125	.
29	.107	48	.065	150	.
30	.104	49	.063	175	.
		50	.061	200	.

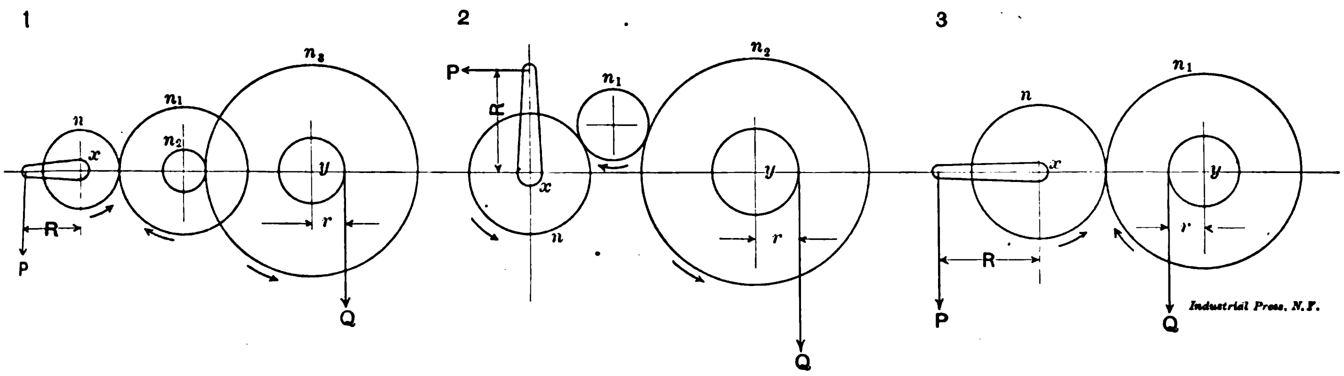
The calculations should be made in the following ma First—Find out if the gears are intended to give a c *velocity ratio* between two shafts, or a certain *power* between the shafts; and, assuming the number of tee one gear, make the number of teeth in the other gear as to have the *required ratio* to the number of teeth i first gear. Second—Assume the pitch of the gears an culate the pitch diameters of the two gears, and the dis

This article is to be published in two installments and places i venient form for reference the information upon gear wheels most needed by draftsmen.—EDITOR.

between the centers of the shafts. Third—Calculate the width of face required to give the gears proper strength. Fourth—Lay out the gears and the tooth forms. The relations of these several steps one to another are such as to make some assumptions necessary and these depend upon the judgment and experience of the designer, especially when the distance between the shafts is approximately settled and certain ratios are to be obtained without materially changing the shaft centers. In the case of the younger designers, however, these assumptions are all made beforehand and given to them with instructions to lay out the gears. The several steps will now be taken up and each explained.

the weight arm times the product of the number of teeth in the driving gears equals the weight.

Fig. 2 shows in tabular form several different forms of gear trains with their formulæ for speed and power ratios. It is to be noted that in place of using the numbers of teeth in these ratios we may use the pitch diameters of the gears, but as these diameters are very often expressed in fractional parts of an inch, while the number of teeth is always a whole number, it is found more convenient to use the latter. Idlers are often used, as shown in the sketch in section 2, Fig. 2, and as they have no effect upon either the speed or power ratios they are introduced either to connect two shafts where the



First Illustration.

Speed ratio:

$$\frac{x\,n\,n_2}{n_1\,n_3} = y$$

Power ratio:

$$\frac{P\,R\,n_1\,n_3}{n\,n_2\,r} = Q$$

Second Illustration.

Speed ratio:

$$\frac{x\,n\,n_1}{n_1\,n_2} = \frac{x\,n}{n_2} = y$$

Power ratio:

$$\frac{P\,R\,n_1\,n_2}{n\,n_1\,r} = \frac{P\,R\,n_2}{n\,r} = Q$$

Note.—As the number of idlers cancels out they do not affect the result.

Third Illustration.

Speed ratio:

$$\frac{x\,n}{n_1} = y$$

Power ratio:

$$\frac{P\,R\,n_1}{n\,r} = Q$$

NOTATION.—$n\ n_1\ n_2\ n_3$ = number of teeth in gears. x = rev. per min. of power shaft. y = rev. per min. of driven shaft. R – rad. of power arm. r = rad. of load arm.

Fig. 2. Diagrams Illustrating Speed and Power Ratios of Gearing.

To Calculate the Ratios Required of a Pair of Gears—Speed Ratios.

Fig. 1 represents two shafts connected by a pair of spur gears, A being the driven shaft and B the driving shaft. If shaft A is required to revolve half as fast as shaft B, it is easily seen that the gear on A must be twice as large, and being of the same pitch must have twice as many teeth as the gear on B. If n and n_1 represent the number of teeth in each gear respectively we have the proportion,

$$y : x :: n : n_1 \quad \text{or} \quad \frac{x\,n}{n_1} = y$$

If now a third shaft were to be driven by gears from shaft A, we could assume A to be the driver revolving y times a minute, and by the above proportion determine the revolutions of the third shaft, and so continue indefinitely for as many shafts as are geared together in any one train.

Thus follows the rule:

The speed of the last shaft equals the speed of the first shaft multiplied by the product of the number of teeth in the driving gears and divided by the product of the number of teeth of the driven gears.

Power Ratios.

In case a certain ratio of power is wanted, we shall find some sort of a crank or pulley, the radius R of which is known, upon the power shaft B, and upon the driven shaft there will also be some sort of a crank, pulley or drum, the radius r of which is known. We can now make the equation (referring to Fig. 1).

$$\frac{P\,R\,n_1}{n\,r} = Q$$

This expression may be made general by following through as before from shaft to shaft, and may be given as the following rule:

The power, multiplied by the power arm, times the product of the number of teeth in the driven gears, and divided by

great distance between centers would involve very large gears if geared directly together, or to effect a change in direction of motion, as may be seen by the arrows in Fig. 3. An inspection of this sketch will prove the rule that an even number of idlers does not change the direction of motion between two shafts, while an odd number of idlers reverses the direction of motion.

Having determined upon the velocity or power ratio required of our gears the next step is to determine the two pitch diameters of the gears. To do this it is necessary to assume the pitch of the gears, and this assumption depends

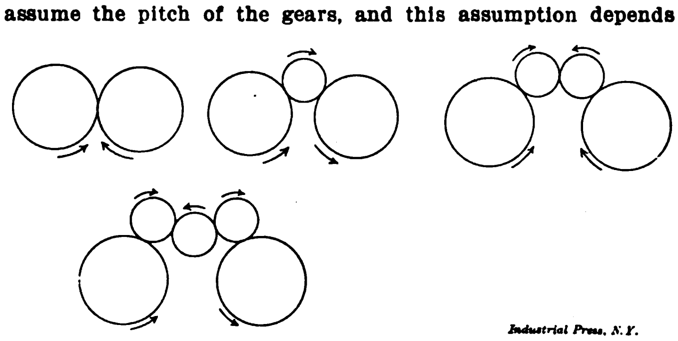


Fig. 3. Showing Effect of Idlers.

upon the judgment and experience of the designer, although very often it may be confirmed by comparison with gears of about the same size and doing about the same work as those to be designed. After assuming the pitch and finding the pitch diameters, a calculation for the strength of the gears will show whether the assumed pitch is right, and if it then proves to be too small or too large this step may be repeated with another assumed pitch.

It is first necessary to understand what is meant by the pitch of a gear, and its relation to the diameter. Fig. 4 shows a gear of twelve teeth (such a small gear is often called a pinion) and the names of the different parts are clearly indicated. As will be seen the circular pitch is the distance on

the pitch circle from a point on one tooth to the corresponding point on the next tooth. The circumference of the pitch circle is equal to the pitch multiplied by the number of teeth and dividing this by 3.1416 gives the diameter of the pitch circle, or

$$d = \frac{p\,n}{3.1416}$$

when, d = the diameter of the pitch circle,
n = the number of teeth,
p = the circular pitch.

After having determined the pitch diameter and drawn the pitch circle we must divide the pitch circle into as many equal parts as the number of teeth, or, what is the same thing, lay off the circular pitch upon the pitch circle. In the case of a small pinion, such as Fig. 4, this may be most easily done by trial with a pair of dividers. It very often happens, however, that the gear is so large as to make this method impracticable because only a portion of the gear showing a few teeth will be drawn. It thus becomes necessary to have some method of accurately laying off the circular pitch upon the pitch circle when only a portion of the circle is drawn. From Fig. 4 it is evident that if we set our dividers to the circular pitch and attempt to step off the spaces, what we shall actually be stepping off will be chords instead of circular arcs, and the resulting arcs will be greater than the circular pitch. In very large gears this error is very small, but in ordinary gears it is quite appreciable, and the dividers should be set to the chord pitch. Table I. has been computed to enable the chord pitch to be easily determined, as the pitch diameter multiplied by the constant k opposite the number of teeth in the gear equals the chord pitch.

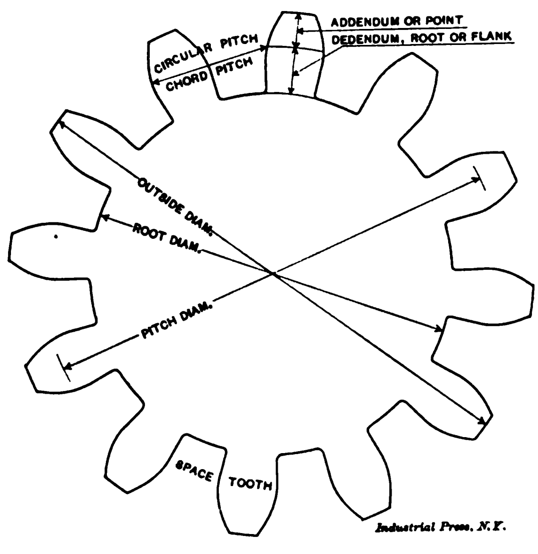


Fig. 4. Chord Pitch and Circular Pitch.

Molded or rough-cast gears are usually designed by circular pitch, but cut gears are designed by what is known as diametral pitch. Since the number of teeth bears a fixed relation to the pitch circumference, and the pitch diameter bears a fixed relation to the pitch circumference, it follows that the number of teeth bears a fixed relation to the pitch diameter. This being so we may divide the pitch diameter expressed in inches by the number of teeth, and the result will be what is termed the diametral pitch. It is also evident that if the number of teeth bears a fixed relation to the pitch circumference and pitch diameter, the circular pitch and diametral pitch must have some fixed relation to each other. These different relations are most conveniently given for use as follows:

Circular pitch $= p$.	Diametral pitch $= P$.
$d = \frac{p\,n}{\pi}$	$d = \frac{n}{P}$
$p = \frac{d\,\pi}{n}$	$P = \frac{n}{d}$
$n = \frac{d\,\pi}{p}$	$n = P\,d$
$D = d + 0\,6\,p$	$D = \frac{n + 2}{P}$
$c = \frac{d + d_1}{2} = \frac{p\,n}{2\,\pi}$	$c = \frac{d + d_1}{2} = \frac{N}{2\,P}$

Relation of circular and diametral pitch.

$$p\,P = \pi \qquad p = \frac{\pi}{P} \qquad P = \frac{\pi}{p}$$

π = 3.1416,
p = circular pitch,
P = diametral pitch,
d = pitch diameter,
d_1 = pitch diameter of mating gear,
D = outside diameter,
n = number of teeth,
N = number of teeth in a pair of gears = sum of the teeth in each gear,
C = the distance between centers of shafts.

When designing cut gears it is not necessary to lay out the form of the teeth, as these are formed by the gear-cutting machine, and it is only necessary for the designer to calculate the pitch diameters that will give the required ratios and then to find the outside diameter of the blank from which the gear is to be cut. For such gears diametral pitch is a great convenience, as the relations of pitch, diameter and number of teeth are so simple.

* * *

MECHANICAL NOVELTIES.

F. W. Harris, Pittsburg, Pa., sends a description of what is known among shop men as a "pick up" trolley. In other words, it is an electric trolley wheel that never slips off. It is, however, suitable only for straight runs.

Fig. 1 shows the trolley wheel and its attachment to the moving crane. Fig. 2 shows the support for the trolley wire.

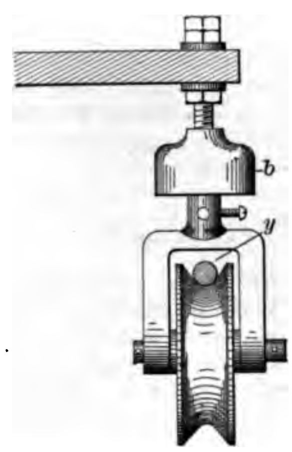


Fig. 1.

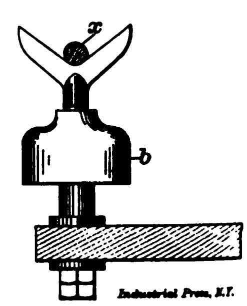
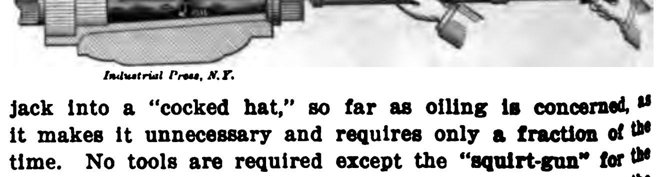


Fig. 2.

Normally the trolley wire rests in the support as at x, Fig. 2, but as the crane comes along the wire is lifted by the wheel to the position y, Fig. 1. As the crane passes the wire again falls into its supports. The knobs b b are of mica, thus insulating the supports and trolley fork from the members to which they are attached.

METHOD OF LUBRICATING WAGON AXLES.

The time-honored way of oiling wagon axles is to remove the axle nut and the wheel, and thus expose the axle to be oiled. On heavy vehicles this necessitates the use of wagon jacks, so lubricating must be done where a wagon jack is available. Hundreds of wagon jacks have been patented, and thousands of them sold. A new scheme knocks the wagon



jack into a "cocked hat," so far as oiling is concerned, as it makes it unnecessary and requires only a fraction of the time. No tools are required except the "squirt-gun" for the oil. The spindles are made with a ¼-inch hole through the center to where the radial holes are drilled to distribute the oil. The opening in the end of the axle is covered by a spring cap. The sketch tells the rest of the story.

ELECTRICALLY DRIVEN MACHINE TOOLS.—2.

THE APPLICATION OF MOTORS TO BORING MILLS.

A. L. De Leeuw.

A great deal of what has been said about lathes is also applicable to boring mills; for a boring mill is essentially a lathe, set on end. The main differences in the two classes of machines are more structural than functional. There are, however, certain points in which the boring mill differs from the lathe, making it necessary to treat this machine by itself.

Fig. 1. Fifty-one Inch Boring Mill with Direct Electric Drive.

In the first place, while a lathe of moderate size is driven either directly by the belt or else by back gears, the boring mill is always driven by a belt in connection with some gearing; that is, there is always some of the gearing left in the boring mill, though the back gears may be disconnected. This, of course, makes the drive more powerful; but, at the same time, does not allow such high table speeds. The higher speeds on the lathe are used for filing and polishing, and these operations are out of place on a boring mill. It follows that the range of speeds needed for a boring mill is governed by the range of diameters to be turned or bored, and to the different cutting speeds, necessary for different materials. Take, for instance, a 72-inch boring mill; the largest diameter to be turned up is, of course, 72 inches, and the smallest diameter to be bored is not likely to be less than 3 inches. This gives a range of table speeds of 24 to 1. Add to this the extreme variations in hardness of work, which may sometimes call for a cutting speed of 15 feet, and then again of 25 feet, and the total range of speed becomes $24 \times \frac{25}{15} = 40$. This is really more than is necessary, for it is not likely that so small a hole as a 3-inch one should be bored with a cutting speed of 25 feet per minute. As contrast, take the 72-inch lathe, with worm drive, illustrated in the previous article. Besides requiring the same range of speeds as the 6-foot boring mill, it also required a filing and polishing speed, for which purpose the faceplate ran 60 R. P. M. In order to have a cutting speed of 15 feet per minute, on a diameter of 72 inches, the faceplate had to run .8 R. P. M. This gives a range of speeds of 75 to 1; and it is not difficult to see that such an extremely wide range of speeds places serious difficulties in the way of the designer, if he wants to avoid high speeds of the various shafts. In the above-mentioned 72-inch lathe, a worm and worm wheel were parts of the driving gear, which was done so as to get great power with few running gears, and consequently, noiseless action. An elaborate system of clutches, levers, etc., had to be placed in the headstock, to enable the operator to quickly change from low to high speeds, and *vice versa*, and to disengage all gears except those actually at work, when running at high speed. Such elaborate mechanisms can generally be avoided in boring mills, for the reasons stated above.

Fig. 1 shows a 51-inch Niles mill, with direct electric drive. In this case the motor was worked on the multiple voltage plan, and its range of speeds was fully as large as the range obtained by the ordinary driving cone. All that was necessary, therefore, was to substitute a sleeve for the driving cone, key a gear to this sleeve, and drive this gear by means of a pinion on the motor shaft. As in the ordinary construction, the cone can be locked to the main driving gear, by means of the stop block; and as the cone was missing here, it became necessary to also key a carrier plate to the sleeve, which carrier plate was provided with notches intended for the same function as the notches in the ordinary cone. The elevating of the cross rail is generally accomplished by a belt, running from a pulley on the countershaft to a pulley on the top brace of the machine. In this case, the same result was obtained by placing a pulley on the aforementioned sleeve, and belting up to the top brace. This pulley, of course, has as many different speeds as the motor; but it is so easy to control the motor speed by simply turning a handle, that the operator is always able to get the speed best adapted for elevating. The drive shown here is of extreme simplicity, and is, I am sorry to say, rather exceptional.

Fig. 2 shows a partly completed 10-foot boring mill. This mill was also driven by a variable speed motor, but the range of speeds of the motor was not quite so large as the range of speeds obtained by shifting the belt on the driving cone of such machines. For this reason, two gears were keyed to the sleeve, which takes the place of the cone. These gears were made to slide in the sleeve, and could be brought in mesh with two pinions keyed to an extension of the motor shaft. This extension was coupled to the motor shaft proper, and the coupling was so arranged as to serve at the same time as elevating pulley. Instead of using two sliding gears, two sets of back gears might have been used. The reasons why sometimes one, and sometimes the other is done, are considerations which lie entirely outside the machine. For instance, it may be that the boring mill is sold when it is partly finished, and that the purchaser requires that the machine be electrically driven, in which case it is too late to put a second set of back gears on the machine.

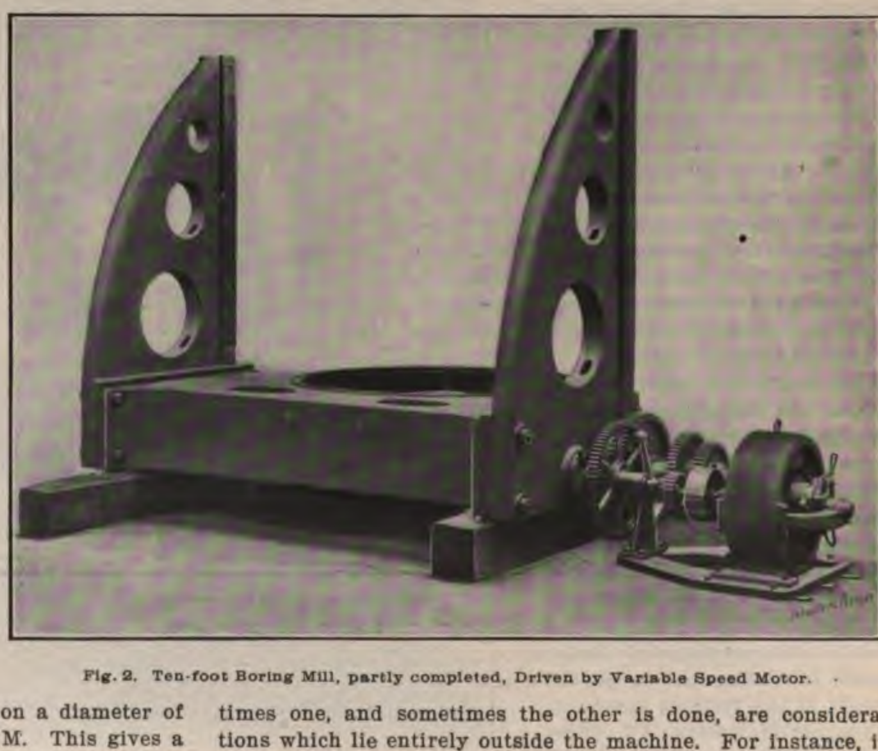


Fig. 2. Ten-foot Boring Mill, partly completed, Driven by Variable Speed Motor.

It may not be amiss to show by an example how this second set of back gears is figured. Suppose the total range

you want to obtain is 48 to 1; and suppose further, that the motor has a range only of 3 to 1; then the question arises, What back-gear ratios shall be used? In order to make all the speeds useful, it is necessary to have them climb up with practically even gradations. It is not absolutely necessary that all the speeds should be in *geometrical progression*, notwithstanding that this geometrical progression is advertised as one of the most beautiful features of every lathe ever built. I know I will be considered a heretic for saying this; but I really and honestly cannot see the good the geometrical progression does. If I had a 6-foot boring mill, with a total speed range of 40 to 1, and with only six speeds, I am sure I would not want these speeds in geometrical progression. To more clearly show my reasons, we will assume that the lowest speed of this boring mill is one revolution in 72 seconds; which gives a cutting speed of nearly 16 feet per minute. The next speed of the geometrical progression is about 2.1 times faster, and therefore corresponds to the proper speed for a diameter of 34 inches. Now suppose I had to turn up a steel plate, or rather ring, 72 inches outside diameter and, say, 36 inches inside diameter. I dare not cut at a higher speed than 16 feet per minute. If I use a 1-32-inch feed, it will take me 11½ hours to take one cut over this plate, because I cannot use any but the lowest speed of the boring mill. Now, what I would do in arranging the speeds of the boring mill would be this: I would bunch several of the lower speeds together, so as to get the benefit of the variable speeds on the larger diameters. Of course I would not get quite as many variations of speed on the smaller diameters as one might have, but then a job on a small diameter never consumes much time; and therefore it does not cause such a waste of time if one has to use a speed which is not quite high enough. It seems to me that some common sense in the arrangement of the speeds of a machine is at least as good as a geometrical progression.

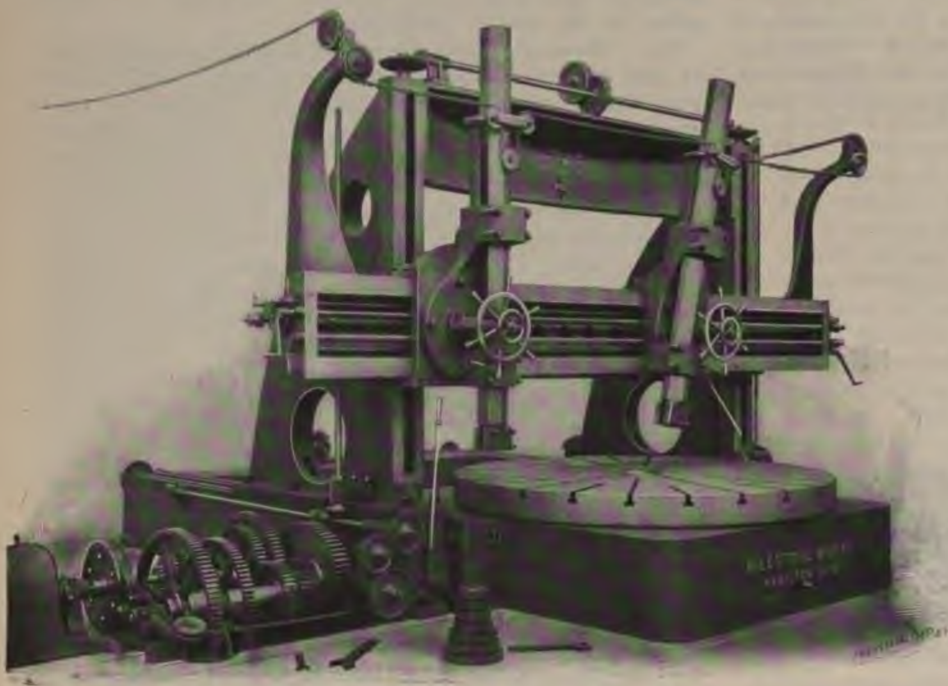


Fig. 3. Ten-by-sixteen Foot Boring Mill, Driven by Motor, with Speed Variation of only Two to One.

To come back to our second back-gear ratio: Starting with the highest speed, that is without any back gears in at all, we may call that speed 48; and we will have to come down gradually to a speed which we will call 1. In the first place, we go down by slowing the motor down. When the motor has reached its lowest speed, the speed of the boring mill will be 48/3=16. If we use the low speed of the motor, and throw the slow back gear in, the speed of the boring mill must be 1; therefore, using the same gearing, with the high speed of the motor, the speed of the boring mill will be 3; and we must now find a second set of back gearing, which will give speeds between 16 and 3. This back gear ratio might be any number, which, divided into 48, will give a speed lower than 16. It might be 3 1-3, 3½, etc.; and by a couple of trials, we find that a second back gear ratio of 4 to 1 makes pretty nearly an equal gradation of speeds. The result will be as follows:

No back gear........speeds 48 to 16.
Fast back gear........speeds 12 to 4.
Slow back gear.......3 to 1.

The use of two pinions on the motor shaft, and two sliding gears on the driving gear sleeve, will give a similar result, though somewhat different numerically. Suppose the back gear were out, and the largest of the two motor pinions engaged; then we would get the highest speed of the driving shaft. Let us call this speed again 48. Going down the range of motor speeds, we shall come to a speed which we will call 16. Now, using the small motor pinion and the highest motor speed, and still without back gear, we would come to a speed which we will call 12. In order to do so, the motor pinions and their sliding gears must be so proportioned that the one will give a speed four times greater than the other. Going down the motor speeds again, we now come to a speed which

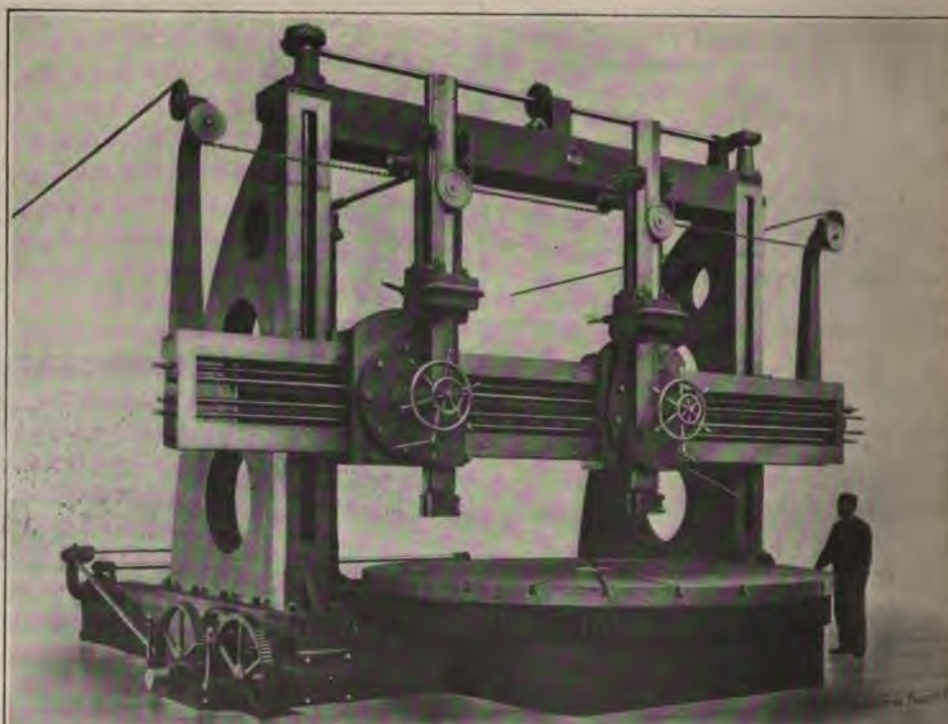


Fig. 4. Extension Boring Mill, 16 by 24 Feet, Driven by a 15 H. P. Two-phase Motor.

TURRET LATHE FIXTURE.

A HANDY ATTACHMENT FOR FORMING IRREGULAR PIECES.

JOSEPH V. WOODWORTH.

The turret lathe fixture shown in the accompanying engravings is for forming pieces of irregular outline from the bar. It is adapted for work having considerable stock to be removed and will duplicate the pieces very accurately and leave the finished surfaces smooth and free from tool marks. As it is always ready for use and can be fastened in place on the turret lathe and set for the results desired in short order, it should find a place in all shops where the value of the turret lathe is appreciated.

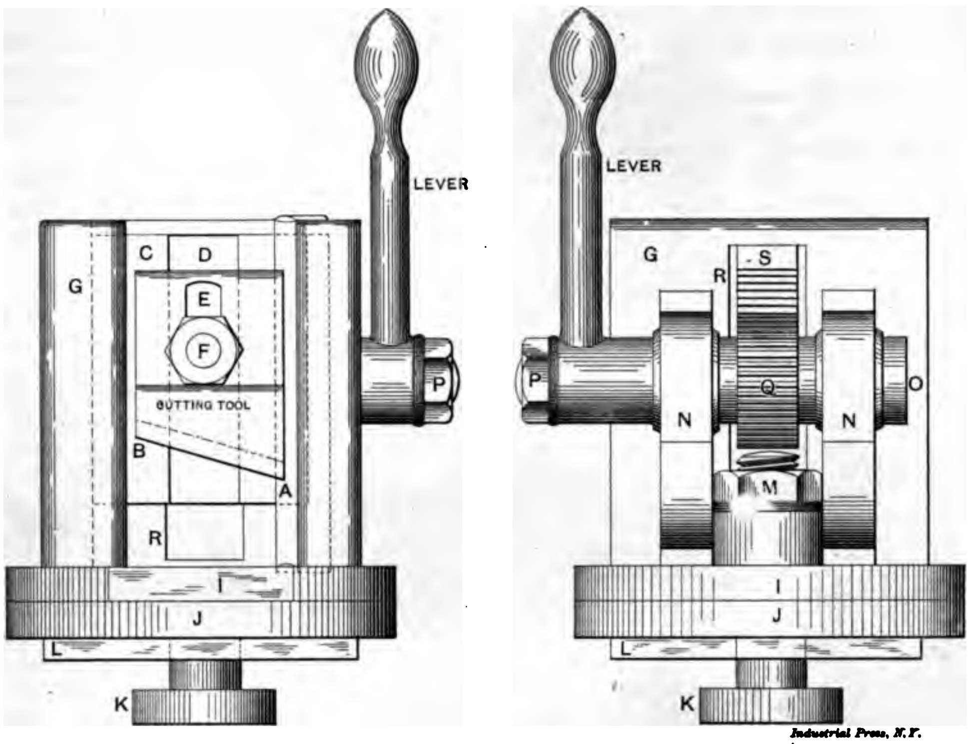


Fig. 1. Front and Back Views of Special Turret Lathe Fixture.

In Fig. 1 are front and back views of the fixture complete, while Fig. 2 is a side view, as the fixture appears when bolted to the back of a turret lathe cross slide. The latter view also shows the manner in which the cutting tool is presented to the work.

The fixture proper consists of two main parts of cast iron—the round base J and the body casting I, constructed to swivel on it. The front G of the body casting is dovetailed and has a gib H for the steel slide C. The ribs N N act as strengthening ribs for the front and also as bearings for the pinion and lever stud O. The steel slide rack S is fastened within a shallow channel in the back of slide C and an oblong opening R allows the rack to project through the front G and mesh with pinion Q. This allows slide C to be moved up or down by the lever at the side. The pinion stud O is of tool steel and has a large head at one end and is reduced and threaded on the other for the lever and fastening nut P. The lever and pinion are keyed to the stud.

The front or face of the steel slide C is finished on an incline at approximately the angle that would be adopted for the front clearance of a lathe tool. This is done so as to avoid having to give this clearance to the cutting tool, which is fastened to the face of the slide, and requires clearance on the bottom only. The cutting tool, as shown in the side and front views, is located within a shallow channel in the face of the steel slide C, at D, and is held by means of the large cap screw F. The cutting edge of the tool is sheared off at an angle as shown in the front view, from A to B, so that it will remove the metal from the work progressively.

The circular portions of the two main castings, Fig. 2, are so constructed that the body of the tool can be swiveled, there being graduations at U U to enable it to be set accurately at the desired angle with the work. The base J is provided with a tongue L, which fits nicely in the slot for the tool post in the turret lathe cross slide. The main casting I is hollow in the center to allow a central hub of the base to project up through it. The bolt K, by which the base is secured to the cross slide, passes up through this hub and thus it is not necessary to loosen the base when swiveling the body casting or tool head. To set the tool head the two nuts T T of the base studs are loosened, and the head set by the graduations to the angle desired. The nuts are then tightened, and the head is rigidly held in position. The manner in which the two castings are finished so as to locate true with each other and swivel, is shown at V V in Fig. 2.

As a practical illustration of the manner in which the fixture is used, there is shown in Fig. 3 a plan view of it as located and fastened to the lathe cross slide, with the cutting tool in position for finishing from bar stock the taper end of a mild steel tool post. For this work a tailstock, equipped with center, replaces the turret usually employed and supports the end of the piece being formed and also acts as a gage for length.

In machining the part shown in Fig. 3, the stock is fed out the required distance, and the spring chuck jammed. The tail center, which is very hard, enters the bar far enough to support it. The handle of the fixture is then grasped by the operator and pulled downward until the lowest point of the cutting tool at A is somewhat near the center of the revolving

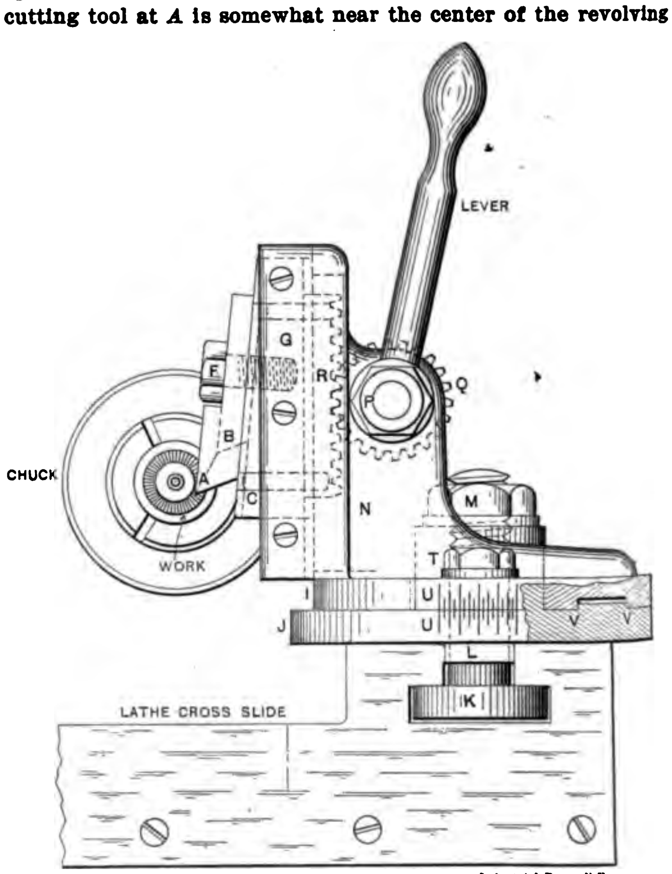


Fig. 2. Side View of Fixture.

stock. The cross slide of the lathe is then fed forward and the tool commences to cut until the slide stops against the stop screw, and the edge of the tool has removed considerable stock. The slide is now held securely against the stop screw,

KEYSEATING TOOL.

A NOVEL TOOL FOR MILLING KEYWAYS, DESIGNED FOR USE IN THE DRILL PRESS.

The subject of the illustrations, Figs. 1, 2 and 3, is a keyseating tool for milling keyseats in gears or pulleys. It is designed to be used in the drill press, the fixture or holder carrying the milling cutter being supported and the cutter rotated and fed through the work by the drill press spindle. In Fig. 1 is a general view of the tool with the parts assembled. The cutter is carried by the cylindrical holder *T* and is driven by the spindle *S*, which is held in a chuck on the drill press spindle, or may be made taper to fit the Morse taper socket in the end of the drill press spindle, or a collet for the same. The method of driving the cutter is novel. In the lower end of the spindle *S* are inserted six hardened pins, shown at *P* in Fig. 2, which project slightly from the end of the spindle and have rounded ends. These pins fill the office of gear teeth and mesh with the backs of the teeth of the milling cutter, the cutter being driven by direct contact with these pins. The handle *H* is for the purpose of preventing the rotation of the holder *T* when grasped by the hand or made to bear against some stationary object.

This tool was designed by Mr. W. L. Schellenbach, of the National Machine Tool Co., Cincinnati, O., and is used for keyseating the gears for the variable-speed countershaft manufactured by this company, to which reference was made in the last number of the paper in connection with a description of a set of turret tools for machining the gear blanks. These gears have holes through the hubs 3½ inches in diameter, which is unusually large for the sizes of gears used. The diameter of holder *T*, Fig. 1, is 1½ inches and the cutter is so located that it projects ¼ inch beyond the outer cylindrical surface of the holder. If the tool were used for keyseating a gear having a 1½-inch hole, therefore, it would be attached to the drill spindle, the drill press started and the tool fed through the hole in the gear wheel by advancing the drill press spindle either by hand or power. As the body of the holder *T* would just fill the hole in the gear, the keyway would be milled ¼ inch deep and of a width equal to the width of the cutter. In keyseating the gears for the countershafts, however, the holes are so large that a bushing must be used for guiding the tool and this is shown at *B* in Fig. 1. The hole through which the keyseating tool is to pass is located eccentrically and breaks through the outer edge of the bushing, making a slot through which the cutter can project as it is fed through the bushing and mills the keyway in the gear.

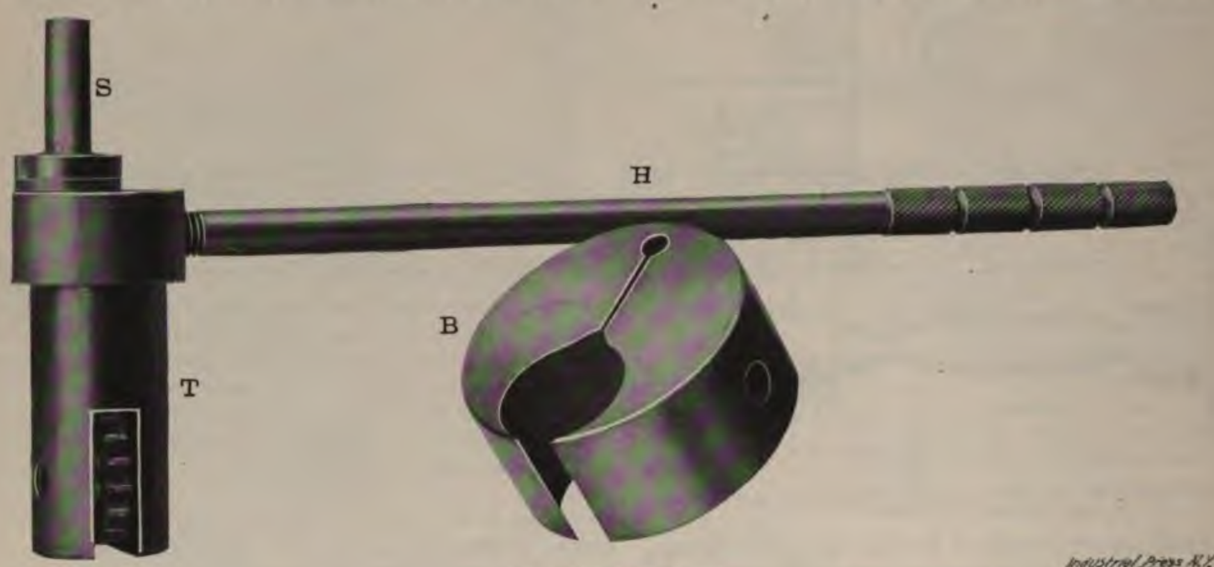


Fig 1. Keyseating Tool.

In Fig. 3 are sketches of all the parts of the tool in detail and they are so clearly represented that further description is scarcely necessary. In fact the sketches tell the story more accurately and completely than would be possible by any worded description. The spindle has an annular groove at *K*, Fig. 2, and the holder has a slot cut to correspond, for the insertion of a key, shown in the end view at the left in Fig. 3, and which extends into the groove in the spindle and prevents end motion of the latter. The key is driven snugly into place and is retained by friction. It will be observed that the direction of rotation of the cutter is such that the cutting edges advance in the same direction as the feed; that is, the cut is with the feed. To prevent chattering and to break up the chips every other tooth of the cutter is grooved at the center and the intervening ones are cut away slightly at their outer edges. One tooth therefore cuts at its center, the next one at its edges, and so on. The cutter does not rotate directly on the cutter pin, but instead a bushing, longer than the width of the cutter, is forced into the hole in the cutter and turns on the pin. This gives a good bearing for the cutter and prevents the latter from wabbling when rotating. The length of the bushing is equal to the width of the slot in the holder in which the cutter is located. At one end of the bushing is a shoulder and at the other a washer, of such thickness that the cutter is centered on the bushing, and it must rotate exactly in the center of the slot in the holder.

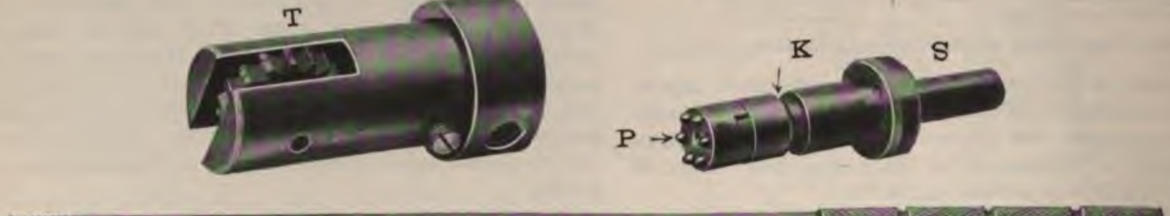


Fig. 2. Showing Spindle and Handle Removed.

This keyseating tool is not only a novelty, but it is efficient and convenient. The pins which drive the cutter do not wear excessively, as might be expected, and are so easily made that it would not be a serious objection if they had to be occasionally renewed.

MARCONI'S ACHIEVEMENT.

HIS INVENTION MAY POSSIBLY BE THE GREATEST OF THE PRESENT GENERATION.

The daily and technical press have already recorded the feat claimed by Marconi, the inventor of the wireless telegraph, of receiving messages from across the Atlantic by means of this system. While his experiments over so great a distance are as yet very incomplete, those of the electrical profession who are best acquainted with Marconi and are in a position to judge most correctly as to the value of his accomplishments, believe the signaling from Cornwall, England, to Newfoundland to have been successfully accomplished. On January 13th Marconi was the guest of honor at the annual dinner of the American Institute of Electrical Engineers, New York City, and many distinguished electrical engineers were present to welcome him and to hear his story of the development of wireless telegraphy. It is an interesting fact that 25 years ago the electrical engineers had as their guest of honor Cyrus W. Field, who did more than any other man toward laying the first Atlantic cable, and that the father of the recently-elected Mayor of New York City was toastmaster at the dinner in honor of Mr. Field. Marconi stated that there are now over 70 ships carrying installations for wireless telegraphy. Of these 37 are in the British Navy, 12 in the Italian navy and the remainder on the large liners such as the ships of the Cunard line. There are also over 20 stations in operation on land in Great Britain. It was explained that through experiments and improvements which have been made it is now possible to arrange the apparatus so that messages will be read only when the receiver and transmitter are attuned, it being impossible for apparatus not adjusted to intercept messages.

This perfected system is not at present in use on shipboard, as it has been deemed necessary that each ship should be equipped with apparatus permitting the operators to read a message sent from any other ship.

Marconi is modest in his bearing and says frankly that he has built very largely on the work of other investigators. He mentioned the names of Clark, Maxwell, Lord Kelvin, Professor Henry and Professor Hertz, to whom he felt deeply indebted and added that, as the message received at St. Johns was heard through a telephone receiver, the name of Alexander Graham Bell should also be included.

The following extract from an article in the Electrical World and Engineer gives several interesting particulars regarding Marconi's latest achievement:

"The readers of Sunday newspapers were treated with a sensation of the first order a few weeks ago by the announcement that Marconi had received during the previous week several signals at St. Johns, Newfoundland, transmitted from Cornwall, England. It now appears that before leaving England Marconi had made plans for accomplishing this result, though it was given out that his object in coming to Newfoundland was to establish a station for communication with ships at sea.

"The distance between the Cornwall station at Poldhu, Cornwall, from which the signals were sent, and that at Signal Hill, Newfoundland, where they were received, is about 2,100 land miles. The signals consisted in repetitions of three dots, corresponding to the letter "S" in the Morse code, and were audible in a delicate telephone connected with the receiving apparatus.

As previously stated, before leaving England Marconi had arranged with the electrician in charge of the Cornwall station, to begin sending signals daily after a certain date, which Marconi would cable him upon perfecting his arrangements at St. Johns. Signal Hill, at the entrance to the harbor, was selected as an experimenting station, and his equipment was installed there. On Dec. 9 he cabled the Poldhu station to begin sending signals at 3 P. M. daily, and to continue them until 6 P. M., these hours being, respectively, 11.30 A. M. to 2.30 P. M., St. Johns time. During these hours Wednesday Marconi elevated a kite with an aerial wire. He remained at the recorder attached to the receiving apparatus, and, to his profound satisfaction, signals were received by him at intervals, according to the programme arranged previously with the operator at Poldhu. These signals, as stated before,

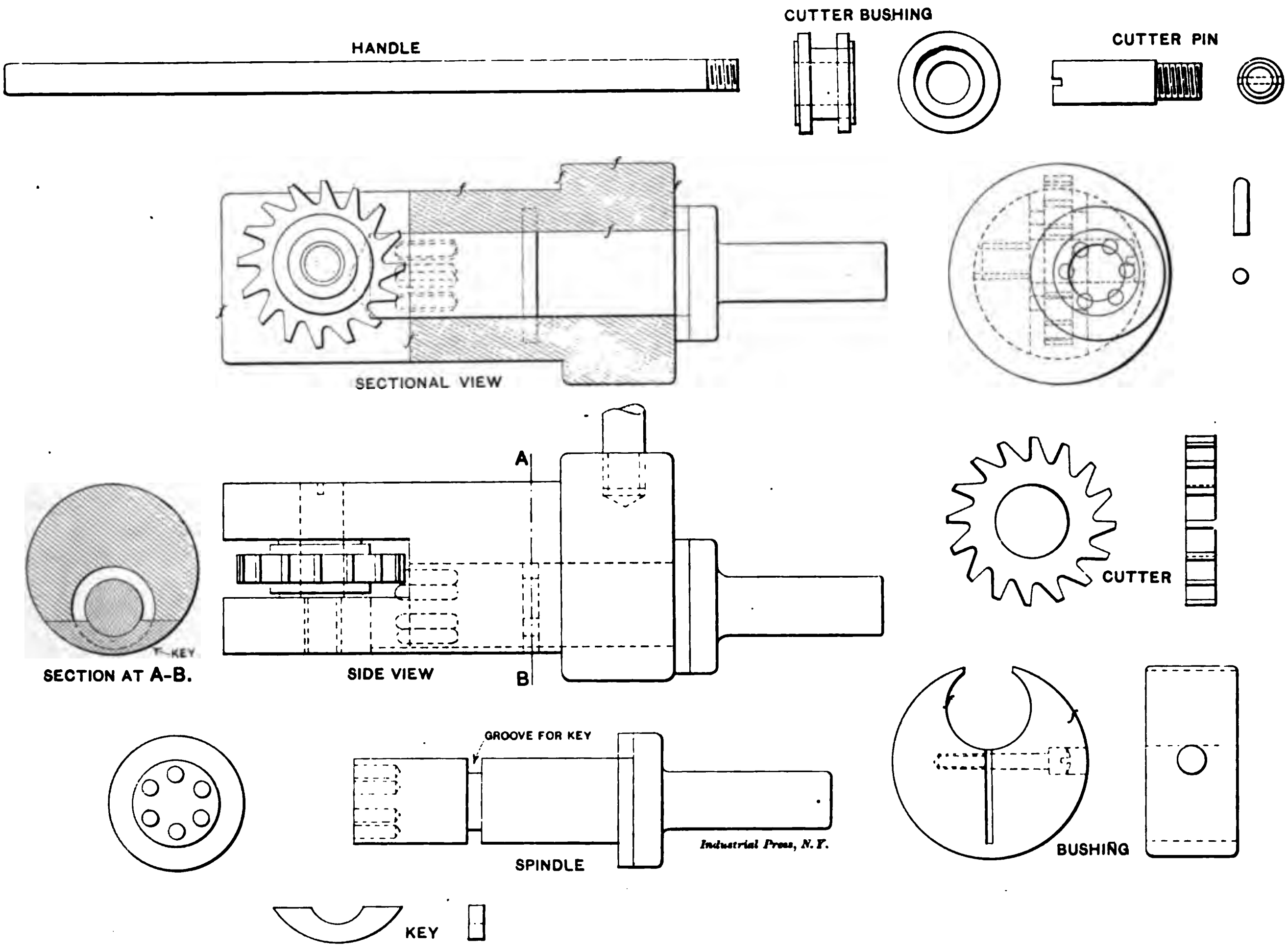


Fig. 3. Details of Keyseating Tool described on the Opposite Page.

consisted of repeating at intervals the letter "S," which is made by three dots, or quick strokes. This signal was repeated so frequently, and according to the detailed plan arranged to provide safeguards against possibility of a mistake, that Marconi was satisfied that it was a genuine transmission from England. Again on Thursday, during the same hours, the kite was elevated and the same signals were renewed.

"Though satisfied of the genuineness of the signals and that he has succeeded in his attempts to establish communication across the Atlantic without the use of wires, Marconi wishes it understood that the system is yet only in an embryonic stage. The possibility of its ultimate development is, however, demonstrated by the success of the present experiments with incomplete and imperfect apparatus, as the signals can only be received by the most sensitively adjusted apparatus, working under great difficulties, owing to the conditions prevailing at St. Johns.

"An unexpected development following the announcement of Marconi's success was a warning from the Anglo-American Telegraph Company that if he persists in his work in Newfoundland an injunction will be served. In a letter served on Marconi on Sunday the solicitors of the cable company gave notice on behalf of the company that the sole and exclusive rights to construct or operate any system or means by which telegraphic communication is obtained from any places in the colony, or within the jurisdiction of the government of the colony, to places outside of the colony, are owned by it; consequently they notified him that the work in which he is engaged is in direct violation of the rights and privileges granted to the company by its charter from the government.

"Mr. Marconi disclaims any intention of infringing upon the rights of the Anglo-American Telegraph Company. He states that he was aware that it has a monopoly there for two years to come, but thought that it was simply an ordinary commercial monopoly, by which no other company could enter into competition, and that he had no intention of competing in the ordinary business sense until their charter had expired.

"Dr. Pupin is quoted as saying that he fully believes that Marconi succeeded in signaling between the coasts of Newfoundland and Cornwall, England, by his system of wireless telegraphy. He states: 'According to the newspaper reports I have read the signals were very faint, but that has little to do with it. The distance, which is about 1,800 sea miles between these two points, was overcome, and further development of the sending instruments is all that is required.

"'One point which is of great value and interest to the scientific world is that Marconi has proved conclusively that the curvature of the earth is no obstacle to the system of wireless telegraphy. Some were inclined to think that the curvature limited the system.

"'All Marconi's efforts of late have been directed toward perfecting and making his sending apparatus more powerful and giving a greater height to the sending end. It still remains to be proved however, that heavy banks of fog, low hanging clouds and heavy showers along and in the path of the transmitted electric wave will not entirely obstruct its progress. The presumption generally is that they will, as experiments thus far have proved them so. Atmospheric conditions have also much to do with and strongly affect the electric wave.'"

* * *

A SHORT TALK ON WRENCHES.

Along with an apprentice's "initiation" by the "gang" into the mysteries of the average machine shop are his lessons in the use of ordinary shop tools. There are, he often learns to his mortification, many wrong ways of using almost any tool, and usually only one right way. The apprentice's shop education consists largely of learning the right way. Even in the use of the often abused but indispensable monkey-wrench (not the "left-handed" kind) there is a right way and a wrong way to apply it to a nut, as every machinist knows. If he does not know it, his shop education has been sadly neglected.

A monkey-wrench applied to a nut in one way will stand a heavy strain without damage; applied in the opposite way and a much less strain may spring the jaws and ruin the tool. The right way to apply a monkey-wrench to *tighten* a rig hand nut or screw is shown in Fig. 1; the wrong way *loosen* a right-hand nut is shown in Fig. 2. The wrench plied as shown in Fig. 1, with the force applied in the dir tion of the arrow, naturally rests against the nut at *A*. Wh the corner of the nut rests against the bar of the wrench *A* the leverage of the sides of the nut to spring the jaws

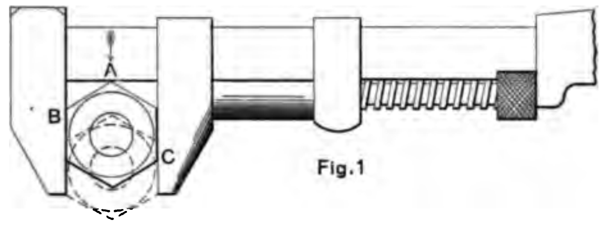


Fig.1

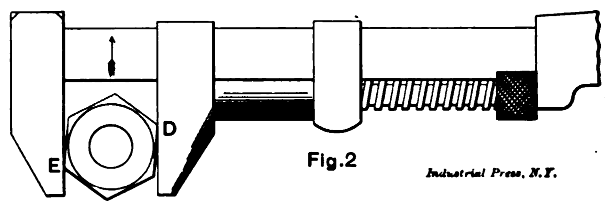


Fig.2

Industrial Press, N.Y.

and *C* apart is the least possible with that size of nut. It quite plain that if the jaws are closed on a nut with the in the position indicated by the dotted lines, Fig. 1, the lev age of the nut to spring the jaws apart is greatly increas over that in the other position.

When the pressure is applied as indicated by the arrow Fig. 2 the tendency is for the bar of the wrench to rece from the corner of the nut (or side, if it be square) and thus increase the leverage tending to spring the jaws apa

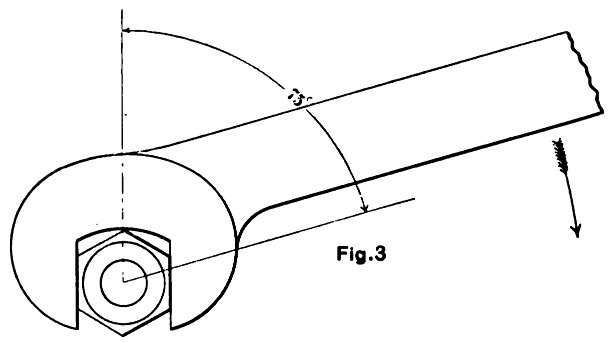


Fig.3

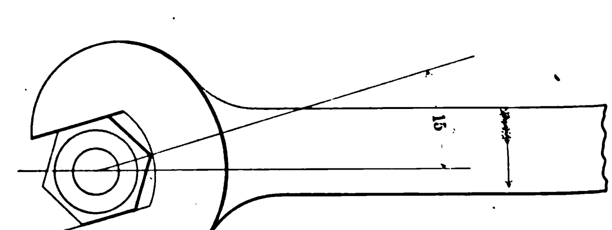


Fig.4

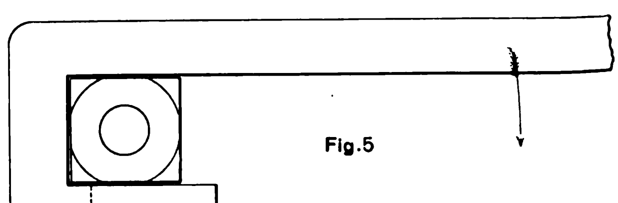


Fig.5

Industrial Press, N.Y.

As the jaws spring the nut slips further out between the and soon reaches such an angular position relative to t jaws that a wrench of many times the strength of the o in use would be required to stand the enormous stress. six-sided or hexagon nut reaches such a position more quick than a square nut, and for this reason a monkey-wrench more easily sprung on a hexagon nut than on a square n

Rules for the Use of Monkey-wrenches.

1.—Don't, if you can find a non-adjustable steel wrench that fits the nut and can use it.

2.—If you must use a monkey-wrench apply it so that the nut or screw will be on the side of the bar toward which the handle is to be turned.

3.—Always adjust the jaws on a nut as tightly as possible when first starting it, and be sure that the jaws go on as far as possible.

4.—A monkey-wrench is not a hammer; don't use it as such.

Drop-forged non-adjustable steel wrenches are now made in all ordinary nut and screw head sizes and in a great variety of styles. Figs. 3 and 4 show two models which are adapted to use in close quarters. With either style of wrench a hexagon nut may be turned when the angular distance through which the handle can be moved is only 30 degrees. The wrench shown in Fig. 4 may not, for the same dimensions, be so strong as Fig. 3 for the direction of stress indicated by the arrow, but it is stronger when both are under stress in the opposite direction. Therefore, since both are likely to be used in both directions, the model illustrated in Fig. 4 is preferable to that shown in Fig. 3. It is also more convenient to use.

The simplest form of wrench for square nuts is that indicated in Fig. 5. It is often employed on large heavy nuts, as it is easily and cheaply made and is much lighter for the same strength than an ordinary open jaw wrench. It must, however, be always used with the turning force applied in the direction of the arrow. In the opposite direction the jaw A is very weak to resist being sprung open by the nut. If always used in the proper manner the jaw A might just as well be shortened to, say, the length indicated by the dotted lines without in any way injuring it so far as its strength is concerned. It is thus made somewhat lighter and cannot be used in the wrong way.

* * *

A SIDE-HILL SCALE.

W. H. Sargent.

The accompanying drawings illustrate one of the peculiar conditions which are continually being presented to the Fairbanks Scale Co. in adapting their railroad track scales to

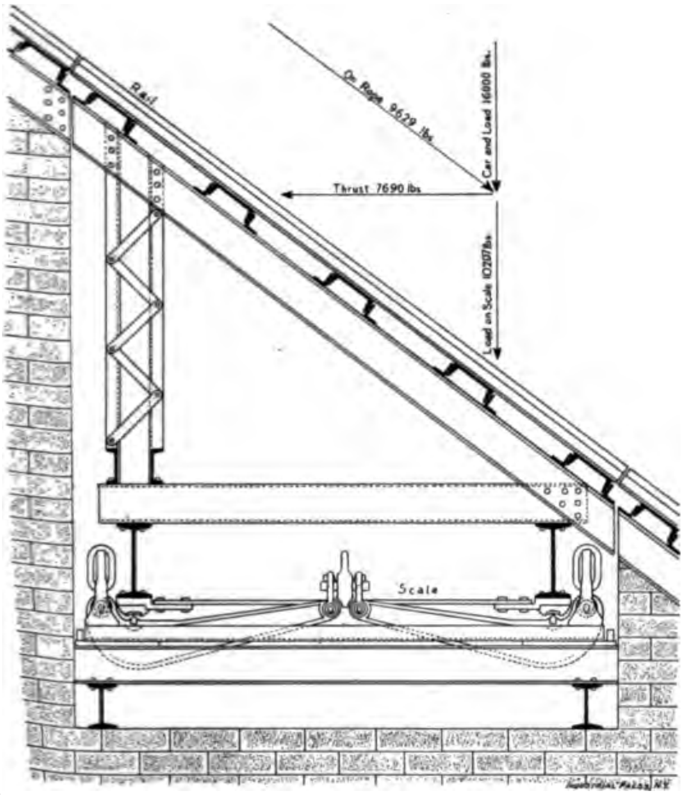


Fig. 1. Scale for Weighing Cars on an Inclined Track.

the demands of present-day business. This particular scale is located in a mine, and the grade is so steep that no locomotive can run over it; the load is, therefore, drawn up the incline by a rope attached to a hoisting engine. Now it is evident that under these conditions the entire load of the car does not come upon the scale, but that a certain portion of it is borne by the rope and that the process of weighing, if performed in the usual manner, will be in error by just this amount. It is possible, however, to so construct the scale that one-half or two-thirds or any other definite portion of a ton may be made to appear as a full ton; hence if we can only determine what proportion of the load is borne by the scale the mechanism may be made to indicate the entire load. This may be performed graphically by laying out a diagram in which lines represent loads and which then may be measured instead of weighed. In Fig. 2 is shown in full lines a triangle $A\ B\ C$ representing the scale with the track $A\ C$ at an angle of 37 degrees. Now from any point D on the line $A\ C$ draw a line $D\ E$ perpendicular to the base and 16 inches long. This 16 inches represents 16,000 pounds—the full load of the car—at a scale of 1,000 pounds to an inch. But this load is partly borne by the rope, pulling in the direction $C\ A$. From the point E, then draw a line $E\ F$ parallel with $C\ A$, which will represent this load. These two motions—the downward tendency of the car and the pull on the rope—exert an intermediate pressure against the rail which would be represented by a line drawn from D at right angles to the rail $C\ A$ and continued until it cuts $E\ F$ at F. This we

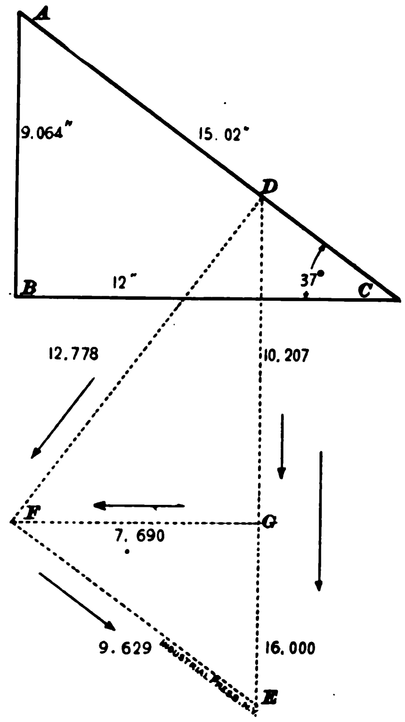


Fig. 2. Diagram representing Loading of Scale.

find to measure 12,788 inches, representing 12,788 pounds, and by scaling the line $E\ F$ we find the load on the rope to be 9,629 pounds. Pulling on the rope also exerts a horizontal motion in the direction $G\ F$ which is indicated as 7,690 pounds. We have now resolved the original load into several components and have determined the push and pull of each. There yet remains the question which we set out to solve, namely, what part of this load of 16,000 pounds is borne by the scale itself, and we will find an answer by scaling the line $D\ G$, which indicates 10,207 pounds.

If the scale is therefore constructed and sealed so that 10,207 pounds on the platform will indicate 16,000 pounds on the beam, it is evident that all other weights will be in proportion and that the scale will weigh all loads correctly.

* * *

Combination machine tools are not often a success. In the machine shop of the Harrisburg Foundry and Machine Works there is a boring mill with a slotting attachment for cutting keyways in flywheels and pulleys. The attachment is not used, however, as it is not considered profitable. Instead a Colburn keyseater is mounted convenient to this boring mill and to another, and is used for cutting the keyways. Each boring mill operator not only tends his machine, but also attends to the keyseater when it is employed on the wheels he has turned. For this added service both employees are paid a small addition to their regular wages. The keyseater is not only much more rapid than the attachment to the boring mill, but its use enables the full capacity of the more expensive tools to be utilized every hour in the day, which is certainly the most economical principle in the operation of machine tools.

* * *

The coefficient of expansion of cement, as determined by recent tests, is from .0000053 to .0000057.

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FEBRUARY, 1902.

REDUCTION IN PIECE RATES.

In the editorial in the December number of MACHINERY upon a Piecework Premium System, the statement was made that with any system of cost reduction it is generally assumed that the manufacturer will increase his profits through the introduction of the system. To this a correspondent takes exception, contending that in the long run it is the customer, not the manufacturer, who gets the benefit of the cost reduction.

He states that the tendency is for the prices of manufactured articles to decrease and that with improvements of the process of manufacture, more agreeable and convenient shop surroundings, and increasing skill on the part of the employés, the output per man will inevitably increase from year to year. Taking these facts as a premise, he contends that there must be a corresponding decrease in the price paid per piece for work, although the earnings per day or week will be as much or more, owing to the increased output; that no greater effort on the part of the workman will be required under the new conditions; and that this decrease must inevitably occur whatever system of wage payment is in vogue—whether a man is working by the day, or at piecework, or by the premium system. He illustrates these points clearly by diagrams drawn to show the relations between profits and wages under the three systems of payment enumerated above. These diagrams are reproduced in another column.

It was not our intention to imply that a cut in piece rates necessarily means an increase in profits solely to satisfy the manufacturer. Such, of course, might or might not be the case in individual instances, but as a general proposition it is undoubtedly true that wages, profits and selling prices are all so intimately related that they form a triangular "merry-go-round," with sometimes one and sometimes another ahead, but on the whole all keeping along together. Selling prices and wages are governed by the laws of supply and demand. They are both influenced by competition. The customer strives to purchase at a low figure and the manufacturer strives to keep down the cost of production to meet the demands of the customer as well as to secure his own profits.

We have no fault to find with the tendency to decrease the price paid per piece, because it is the natural order of industrial development that such should be the case. We do object, however, to the way in which such reductions are sometimes made. Automatic machinery and improved appliances are legitimate causes for such reductions; but where a workman, through extra effort, diligence or study is able to increase the output, it is not in the spirit of fairness to immediately cut the rate. He should be able to earn more under such conditions than when working by the day, and the price set should be high enough and allowed to remain long enough to compensate him for his efforts.

We believe that the piecework system offers the temptation to cut the rates unfairly where some other systems do not, and for this reason we suggested that it might be more equitable to incorporate with the piecework system some of the features of the premium plan of payment. Under the latter arrangement a man is guaranteed his day rate and is paid over and above this a certain percentage of what he earns if he produces more than a stipulated amount of work in a given time. By adopting a similar plan when paying for work by the piece, a frequent cut in rates—usually supposed to be inseparable from the piecework system—would become unnecessary, because the matter would automatically adjust itself and both employer and employé would receive his pre-determined share of the earnings.

* * *

SECRETIVENESS REGARDING MANUFACTURING METHODS.

It is generally understood that most manufacturing establishments in European countries are not freely opened to outsiders, but, on the contrary, it is difficult for anyone not connected with a concern in some capacity to obtain admittance under any pretext. This policy is rigidly adhered to by the largest works, notably that of Krupp, at Essen, Germany, as well as the smaller ones. So when a European shop is found which freely affords opportunity to inspect its methods of manufacture it has departed from the established policy of exclusiveness which marks the great majority.

Some years ago a leading manufacturing company of the United States established a branch factory in France for making their products. Following their general policy as to shop hospitality all who were interested in their products and manufacturing machines and methods were freely admitted to the works and special pains taken to show them the improved machinery and the special appliances developed and in use for reducing manufacturing expense. The amazement of most of the French engineers who were granted these favors is said to have only been equaled by the appreciation of, to them, unexampled courtesy. They expressed their wonder as to the policy which made public that which would have been most zealously guarded in most French shops and regarded as an asset which would be lost if divulged to the public.

That the American company mentioned have not lost prestige or business by not following a policy of secretiveness goes without saying, and if proof were needed it is only necessary to point to the volume of business now transacted by them, which is many times that of the time when the French factory was opened. The secret of their success must, therefore, not lie in "keeping things dark," but undoubtedly in their policy of progressiveness which does not permit of standing still in the development of their product or of the machinery for its manufacture. It is said that this company and their allied interests spend annually not less than one-half million dollars in experiments and investigation work. Of course, the principal part they play in the development of machine tools is that of offering a ready market for any machine which increases productive capacity, and such should be the attitude of all manufacturers who are seriously in the industrial race.

A shop in which the policy and methods have crystallised into an unchanging form may be safely said to be unprogressive, and unless their product is of the nature of a monopoly the chances are that it will soon be left behind by more wide-awake and industrious competitors. Secretiveness as a shop policy may have certain advantages, but it is doubtful if they compensate for disadvantages thereby entailed which we need not enumerate. It is certain that such a policy cannot make up for progressiveness, and progressiveness seems impossible to any great extent when secretiveness is the rule.

NOTES AND COMMENT.

John G. Sadlier, of the Springfield Foundry Co. and the Fairbanks Machine Tool Co., died on January 6th from a pistol shot inflicted by an employé whom he had previously discharged. At a very early age Mr. Sadlier was apprenticed in the shops at the Cambria Iron Co. Later on he was oreman for several large foundries in Ohio, and finally became a member of the Springfield Foundry Co.

Marcellus Hartley, president of M. Hartley & Co., of the Remington Arms Co. and of several other large firms engaged in the manufacture of fire arms, died suddenly in New York, January 8th. Mr. Hartley was born and educated in New York, and while still quite young became interested in fire arms. He thus acquired a knowledge which later was of great service to the U. S. Government, as during the late war the Secretary of War sent him to Europe to purchase arms for the Union army. Mr. Hartley was a member of many clubs, scientific and otherwise, and was also interested in numerous charitable organizations.

The electric power plant at Niagara Falls has been in operation eight years. If it were to be built to-day and the same thorough-going method used in its design and construction were applied to-day, the eight years of experience since that time would not enable the engineers to improve the plant to affect the cost of power one dollar per kilowatt year. This is the judgment of Mr. L. B. Stillwell, expressed in a paper recently read before the American Institute of Electrical Engineers. No better tribute could possibly be paid to the wisdom of employing the very best available engineering talent in important works involving large expenditures. As industrial progress brings greater and greater engineering problems in all branches of activity, this policy should be widely extended. In such busy times the temptation to provide for the present is very strong. A better policy is to look as far as possible into the future and secure the best because it will last and because it will be good while it lasts. There is little of the engineer's work which does not last many years, whether it is an electrical plant, a bridge, a tunnel, a locomotive or a shop.—*American Engineer.*

The work of the engineers in connection with the Niagara Falls plant appears to even better advantage when it is remembered how rapid has been the development of power plants and the use of electricity since the establishment of the station at Niagara Falls. Large direct-connected units, with a maximum of 2,000 H. P., began to be used about 1892, but the immense units of several thousands of horse power now running in New York City and elsewhere have come into existence within three years. They are made possible mainly by the perfection of the slow-speed generator and the improvements in forged steel engine parts such as are produced at Bethlehem and elsewhere. At the Niagara Falls plant the engineers were enabled to use large units with the massive rotating fields of the generators through the facilities of the Bethlehem Steel Co., which enabled them to forge immense field rings capable of rotating at high speed with perfect safety. In the matter of distribution of power it should be remembered that it is only about ten years ago that electrically-driven tools came into existence.

THE NORTH GERMAN LLOYD'S AUTOMATICALLY-CLOSING BULKHEAD DOORS.

Recently an exhibition was given by the North German Lloyd Steamship Co. of a safety device that has been applied to their new express steamer, the "Kronprinz Wilhelm," in the way of a system of automatically-closing bulkhead doors, whereby all parts or sections of the hull of the ship may be instantly isolated from one another in case of collision or other accident to the vessel.

The hull of the "Kronprinz Wilhelm" is divided below the water line into 17 water-tight compartments, or bulkheads, and for ease of access between these there are provided 21 tight closing doors; it is upon these doors that the safety of the vessel after an accident depends, as if the compartment adjacent to the injured section of the hull may be perfectly shut off from the remaining compartments the ship may proceed to port in safety. In the system applied by the North German Lloyd, which is known as the Dorr system, the doors slide in vertical ways, and are closed automatically by hydraulic pressure controlled from an operating wheel on the bridge behind the pilot house. The system has been applied to the 21 bulkhead doors below the water line. In order to operate the wheel on the bridge, a trip lever has to be elevated out of the way to unlatch it, and by an ingenious ratchet arrangement, it requires some 20 seconds before the wheel is free to turn. While this lever is being moved, electric bells are sounded at every bulkhead door, giving warning for about 20 seconds before the doors begin to close from the action of the hydraulic cylinder, so that the attendants may get out of the way. The doors may, moreover, be closed by hand, independently of the hydraulic apparatus, and a lever is provided at each door by which it can be made to drop into its closed position almost instantly. An ingenious system of electric signals has been adopted in connection with the doors all over the ship.. In the pilot house is a large diagram, showing all the decks, and at each point where there is a bulkhead door a small bull's-eye is placed. Behind these bull's-eyes are signal lamps connected to switches at the doors in such a manner that whenever a door is closed the lamp is lighted. In this way the officer on watch has the position of the bulkhead doors throughout the entire ship directly under his eye.

It will be remembered that the "Kronprinz Wilhelm" is the latest addition to the high-speed fleet of the North German Lloyd Steamship Co., having arrived in New York on her maiden trip during September last.

THE COOPER-HEWITT VAPOR LAMP.

Some new patents recently granted to Peter Cooper-Hewitt for improvements on his remarkable vapor lamp are again bringing before the minds of the public the question of the future possibilities of this form of electric lighting.

It will be remembered that the characteristic feature of the Cooper-Hewitt vapor lamp is the use of a vapor of metallic mercury as the conducting substance in the lamp instead of a solid conductor at incandescence as is used in the incandescent lamp; while its remarkable advantage from the commercial standpoint is the production of a given candle-power at about one-sixteenth of the cost of the same candle-power produced by incandescent lamps. In its usual form the lamp consists of a long glass tube containing a small amount of mercury at one end surrounding one of the inserted electrodes, the other electrode being inserted at the other end of the tube; but the size or shape of the tube is not fixed—many different shapes and sizes having been experimented upon by Mr. Cooper-Hewitt. It is also to be understood that while the tube is not rarified to a vacuum as is the incandescent lamp bulb, still it is exhausted to a very slight extent. The passage of a current through the tube causes the production of a very brilliant light and at a very low cost per candle power, but the light has a rather peculiar uncanny appearance which is stated to be due to the absence in its spectrum of the red rays of the solar spectrum. The light produced by this pure mercury gas comprises orange-yellow, lemon-yellow, green, blue, blue-violet and violet, but the absence of the red is said to render the light impracticable. The other disadvantage of this form of lamp from a commercial standpoint is the fact that the passage of current through it must be accomplished in starting by a high potential or other means of overcoming the high initial resistance of the conducting vapor, as a potential sufficiently high to maintain the flow after being started is far from being able to start. Also the temperature of the lamp rises to a very considerable extent when in operation as, in fact, the light-producing action seems to be substantially that of electric arcs in the conducting vapor, and it is indeed a question whether the glass of the tubes would be able to withstand the protracted heat in practical service without breaking or deteriorating.

An interesting exhibition of the Cooper-Hewitt lamps was made at the recent January meeting of the American Institute of Electrical Engineers. Lamps of the horizontal type of 600-candle power were shown in continuous operation and they naturally created a great deal of interest. The current by which they were operated was the standard 118-volt New York Edison lighting supply and the current consumption per candle power was found to be from 0.35 to 0.40 watts, which is only about one-twelfth of that required by incandescent lamps.

ELECTRICAL OPERATION OF TOOLS.

ABSTRACT OF A LECTURE BY ROBERT T. LOZIER BEFORE THE NEW YORK ELECTRICAL SOCIETY.

At a recent meeting of the New York Electrical Society a paper was read upon "The Electrical Operation of Modern Tools and Machinery" by Robert T. Lozier, district manager of the Bullock Electric Mfg. Co., 220 Broadway, New York. The extracts from the lecture which follow bear directly upon the use of electric power transmission in machine shops.

Perhaps the most interesting feature of the subject is comparing the electrical operation of tools and machinery, either by a subdivision of the power, or individual application, with the old method of transmitting power from the main engine entirely by belts and shafting. At the present time the new shops that are driven entirely by belt transmission are in the minority and generally operate under conditions of such peculiar nature as to make the shaft and belt system particularly desirable.

At the meeting of the American Society of Mechanical Engineers in December, 1896, Prof. C. H. Benjamin read an exhaustive paper on the losses in the distribution of power in machine shops, giving the results of very thorough tests in 16 different establishments. The accumulated data are briefly summarized in the accompanying table, which shows that the

	Length of Line Shaft.	Total H.P.	H. P. to Drive Shaft. &c.	·Per Cent.	At What Capacity.
Wire Drawing and Polishing	1130	400	157	39	One-half
Stamping and Polishing	580	74	57	77	One-third
Boiler and Mch. Tools	580	38	25	65	Two-thirds
Bridge Machinery	1460	59	48	81	Nearly full
Heavy Machine Tools	1120	112	64	57	Full
Heavy Machine Tools	1065	168	91	54	Full
Light Machine Tools	748	40	20	51	Full
Manufacture of Small Tools	500	74	40	54	Full
Manufacture of Small Tools	990	47	24½	51	Full
Sewing Mchs. & Bicycles	2490	190	108	57	Full
Sewing Machines	1472	107	75	70	Full
Screw Machinery	1800	241	114	47	Full
Steel Wood Screws					
Manufacture of Steel	674	117	17	14.5	One-quart'r
Nails	988	91	45	50	Full
Planing Mills	165	39	28	73	Full
Light Machine Tools	275	8	4	50	One-half

Average loss, 55 to 65 per cent.

average loss involved in the transmission of power represents from 55 per cent to 65 per cent of the total power generated. Say it is 50 per cent of the total power, then it will represent 100 per cent of the effective, or useful, power. If we have a plant of 100 H. P., and it requires 50 H. P. to operate the tools, and 50 H. P. to get the power to the tools, we are losing 100 per cent of the effective, or useful, power. And we must not forget that this loss is fixed and is not reduced as the load diminishes, so that if the useful power should drop to 25 H. P., this waste power would become 200 per cent of the effective power.

Prof. Benjamin in analyzing the distribution of power in the shop, says: "Stating the case roughly for the ordinary machine shop, every 100 indicated H. P. of the engine may be distributed thus:

Friction of Engine	10 H. P. or 10 per cent.
To drive Shafting	15 H. P. or 15 per cent.
Belts and Pulleys	15 H. P. or 15 per cent.
Empty machines	15 H. P. or 15 per cent.
Cutting material	45 H. P. or 45 per cent.
	100 H. P.

"Even this efficiency would probably be realized only when all the machines were working at their full capacity."

He thus found the average loss in getting the power to the tool to be 55 per cent of the total, or 122 per cent of the effective, while in the test on the group system, operated by motors, taken on the basis of 100 feet of line shafts he found

Motor and Shaft	12 H. P. or 30 per cent.
Machines	28 H. P. or 70 per cent.
	40 H. P.

It will be noted from the foregoing that driving and transmitting force is but 43 per cent of the effective, instead of 122 per cent in the case of all-belt driven. Prof. Benjamin does not state whether he has included in the motor unit its proportionate share of line loss, 5 per cent, and generator loss, 8 per cent. But these latter are more than offset by the circumstance of the tools being shut down when all loss is stopped.

Mr. Gano S. Dunn, in a paper presented before the American Institute of Electrical Engineers, on April 26th, 1899, put the problem as to whether it was advisable to use 100 feet of shafting driven by one motor, or three groups of 33 1-3 feet each, driven by three smaller motors, as follows: "Taking a duty of 1 H. P. upon the shaft for every five feet of length. corresponding to like machine-shop practice, and taking a coefficient of friction of 5 per cent, and a speed of 200 revolutions, transmitting 200 H. P. with the belts pulling horizontally in opposite directions, we find the per cent of saving in using three small motors, instead of one, is 2 per cent."

This is getting the question of economy down pretty fine. In this statement Mr. Dunn puts in the hands of the engineer means of determining how far the question of sub-division of the prime movers can be carried, purely from the standpoint of efficiency.

Of course, if a separate motor is applied to each tool, the loss in transmission becomes almost negligible, in spite of the theoretical losses that are sometimes attributed to the slow-speed motors that may be used in that system. In large plants in which the individual motor is freely applied it is found that the average load of the generating plant is but 1-6, or 16 2-3 per cent of the total connected load, including the electric lighting, cranes and trams; that is to say, if we have a plant, the motors and lights of which aggregate 1,000 H. P., it is not unreasonable to expect that the demand upon the generating plant will run about 166 H. P., and that this demand will not exceed the maximum of 250 H. P. for a considerable length of time; so it will be seen that a plant with such a large connected load can turn out its considerable product with a remarkably small expenditure of power.

Now what does this question of economy in power represent in dollars and cents to the producer? Prof. Chas. E. Emery, in his paper of March 23rd, '93, before the American Institute of Electrical Engineers, tells us that the costs of producing a mechanical H. P. are as follows:

With coal at $3.00 per ton for simple, high-speed, non-condensing engines, for 10 hours a day for one year (about 500 H. P. generated), $36.17 per H. P.; with special low-speed triple compound engines, $24.19 per H. P.

From these costs it is not difficult to determine what ratio the cost of power bears to the product of the shop which it drives. From empirical data I am able to state that the average ratios run pretty close to the following:

Complete Belting Transmission.

With the cost of steam power at $36.17, 2 per cent of product.

With the cost of steam power at $24.19, 1 2-3 per cent of product.

Subdivided Motors.

With cost of steam power at $37.17, 1 per cent of product.

With cost of steam power at $24.19, 0.8 per cent of product.

Individual Motor Drives.

Here the amount of power involved is so small as to increase the cost per unit, but I have known it to be less than 4 per cent of product.

Assume a locomotive shop, a large cloth-printing concern, or any other establishment in which a large amount of power is used in running its machinery to produce an output which we say amounts to one million dollars a year; and if we assumed that they use the very best methods of producing their power we find the cost of that power, per year, with the different methods above outlined, to be as follows:

Method of Drive.	Cost of Power.	Yearly Saving.
All belts and shafting	$17,000	
Sub-divided Motors	8,500	$8,500
Individual Motors	4,000	13,000

So that a sub-divided motor system saves enough over the old method of belt and shafting to pay 10 per cent yearly on a plant that would cost $85,000, and the individual motor ap-

plication could support, at that rate, a $130,000 plant. Of course the latter need not be entirely composed of individual motors, but groups of small machines can be driven by one motor whenever that method seems best.

From the foregoing figures we can tell, with reasonable closeness, what this subject of economy in power transmission means, and how far it will go toward representing the interest and depreciation upon the plant that it is necessary to purchase, in order to accomplish such savings. The figures are given from a broad standpoint; they have been gathered from actual plants now in operation and may be taken to fairly represent general conditions. So much for the question of economy.

In every line of the civilized world people are endeavoring to increase the sphere of action by increasing the quickness of operation. We use the telephone because it is quicker; trolleys because they are quicker; automobiles because they are quicker; and one of the greatest factors in determining the speed of the trolley and the automobile is the quickness of their control. The question is asked on every hand, What is the quickest method we can apply? not what is the cheapest in first cost, nor in which the smaller economies are apparent.

Let us, therefore, leave the question of what we are going to save in power transmission and other considerations of relatively minor importance and go at once to those matters of increased output and entire flexibility in the arrangement of the shop equipment.

It is true that the individual motor, properly controlled, can increase the product of an establishment. I have it on good authority from several sources where such equipments are used that the outputs have been increased from 8 per cent to 25 per cent with the same equipment and pay roll, due directly to the use of these motors, which many times are used in conjunction with a group drive system.

If it is true that with increased speed facilities we can increase the output, and we limit that output, in the case of the individual motor, to say 10 per cent, and that is low enough to cover the increase in most any kind of a well arranged plant, then let us consider the case that we took as a basis to determine the relative cost of transmitting the power—an establishment producing a million dollar product yearly. If we can increase this product by 10 per cent, we have $100,000 more with the same shop equipment and the same expenditure for fixed charges and pay roll. Allow for raw material, say $25,000, and we can credit the motor equipment with $75,000 a year.

This will probably more than pay for the entire equipment of individual motors in the first year, and in addition, the purchaser has the saving in power transmission, a free and clear head room permitting of the use of over-head cranes, which in these days of rapidly moving machinery we must have to handle the product. He is able to reorganize and rearrange his shop at any time, to remove old tools and make room for new.

To indicate the success of the individual motor in fulfilling all the demands put upon it, some of which have been almost abnormal, I will refer to the equipment of the shops of the Fore River Engine Co., of Quincy Point, Mass., a large establishment designed in accordance with the latest and best engineering practices and one in which the individual motor drive is giving a practical demonstration of its complete success.

This plant has a connected load, consisting of motors, arc and incandescent lights, of nearly 3,000 H. P. and its average load is about 260 H. P. This latter item may be increased as more work is put upon the tools. The load at present is distributed among 112 motors, half of which are of 5 H. P. or under. To get an idea of the service put upon an individual motor, I have here to-night some data on some very heavy turning work, and have samples of the chips. The tool was a 60-inch lathe, running with all back gears in head of lathe, the motor of 6½ H. P. capacity, operating at full line voltage. Results were as follows:

Photographs of the Fore River Engine Works were shown in the June, 1901, number of MACHINERY. The large lathes above referred to were built by the Fitchburg Machine Tool Works and illustrated in the September, 1901, number.—EDITOR.

Machining 20-inch steel shaft 32 feet long, weighing nearly 24 tons, taking two chips, one tool following the other. Feed was ⅜ inch. Cutting speed 18 feet per minute. Line voltage 235. Amperes, no load (rotating steel shaft only), 36; 12 H. P., or 66 per cent of motor load. Amperes with average load, 45; 15 H. P. or 250 per cent of motor load. Amperes with maximum load, 80; 26 H. P., or 433 per cent of motor load.

Owing to the excessive overloads it was necessary to change one set of brushes. It was, however, an emergency job, the motor was kept at its work, and Mr. F. O. Wellington, the general manager of the company, stated he believed it to be the quickest job ever done with so large a piece of material. The motor did not heat excessively, although it stood at over 300 per cent overload for periods of at least half a minute."

Mr. Lozier went exhaustively into the various methods of speed control, closing by saying that if individual motors were to be used it was of great importance that they be large enough, advocating a margin of at least 25 per cent over what was supposed to be a generous estimate.

* * *

POWER TRANSMISSION WITH LOOSE BELTS.

There is a system of belt transmission in use at the works of the Tide Water Oil Co., Bayonne, N. J., which enables belts for the transmission of power to be operated satisfactorily when very loose on their pulleys. So far as we know the system is new. It consists, simply, in using a very loose belt to transmit the power and in running a narrow "keeper" belt on the outside of the main belt, the keeper belt being put on with about the same tension as ordinary tight belts.

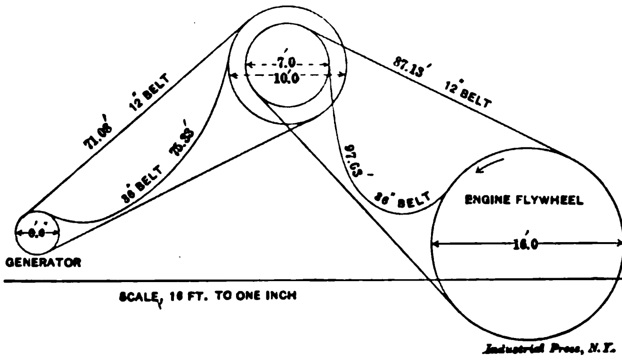


Diagram of Belt Drive.

The sketch shown herewith was furnished by Mr. J. E. Morse, mechanical engineer of the Tide Water Oil Co., and is a diagram of the belting from a Corliss engine to a jack shaft and from thence to a 250 K. W. three-phase generator. The main belt is 36 inches wide. The sketch is drawn to scale and it will be seen that this belt is very loose indeed. On the outside of the main belt is a 12-inch belt with sufficient tension to keep the main belt in close contact with the pulleys and to prevent the under or driving side of the belt from sagging. The belts are transmitting from 200 to 300 I. H. P. as the load on the generator changes and the engine is running 70 revolutions per minute, which gives a belt speed of 3,519 feet per minute. Assuming that the wide belt is transmitting all the power, which, of course, is not strictly true, one horse power is being transmitted per 420 feet belt speed for each inch in width of belt, when run up to the maximum capacity. This is a very creditable showing.

Mr. Morse writes that by this system he gets upwards of 30 per cent. more contact with the pulleys than where tight belts are used and that the trouble caused by stretching the 36-inch belts has been done away with and the life of the belts has been increased. Whether or not there is less friction in the bearings has not been determined with certainty.

The main object of the keeper belt in this case is to prevent the wide belt from jumping when starting and stopping, although the keeper adds largely to the adhesion of the inner belt and so increases the amount of power that a loose belt can transmit. In cases where the main belt is not heavy enough or the span between the pulleys great enough to enable a loose belt to transmit the desired amount of power,

the keeper can easily be proportioned to increase the adhesion between the pulleys and belt sufficiently to make the belt work as it should. In this connection it may be added that when a loose belt has once started to run smoothly there is a very marked tendency for the belt to hug the pulleys. In an installation of the Hill system of belt driving, in which binder pulleys are employed to increase the arc of contact on the pulleys, we have known of one of the binder pulleys being slacked off while the belt was running and the belt continuing to adhere to the face of the driving pulley for two or three minutes, and this, too, where the belt was nearly vertical. It would seem, therefore, that a loose belt may be made very efficient by the addition of a keeper belt, even when the distance between pulleys is not great enough for such a belt to carry the load under ordinary conditions.

* * *

WAGES AND PROFITS.

A correspondent sends us the diagrams published herewith, showing the relations between profits and wages under day work, piecework and the premium plan of wage payment. These diagrams are drawn under the assumptions that the selling prices of manufactured articles gradually decrease, in the natural order of things, and that the capacity for doing work gradually increases among any class of workmen. Our correspondent writes, "Production increases as the result of many intangible things; for instance, better lights in the shop, better arrangement of tools, less delay in furnishing stock, better stock, better tools, better oil, higher speeds, greater cleanliness, and even good temper in the shop increase the speed of the work, while perhaps the workman sees absolutely no change. These improvements are going on continually with the progress of the age, so that almost every man is doing better than he used to, although perhaps he may not realize there are any changes in the tools or appliances he is using."

Under these conditions it is assumed that the price paid per piece must in consequence gradually become less, in order to meet competition, although the wages per day will not be reduced and in fact may and probably will become slightly higher as time goes on.

Our correspondent adds, "To express the matter by diagrams, we have sometimes said that if a workman worked at the same rate per day, and became more skilled, all the profit would go directly to the manufacturer or the customer; if he worked by piecework, all the profit would go at once to the workman, then he would be cut down and perhaps make a slight loss, to the advantage of the manufacturer; again, if the premium system were employed, part of the profit due to increased skill would go to the workman and part to the manufacturer or the customer, but even under the premium system, in time there must be readjustment to meet competition."

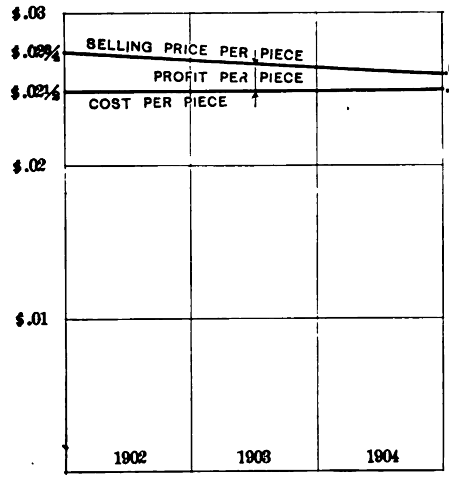


Fig. 1. Piece Work.

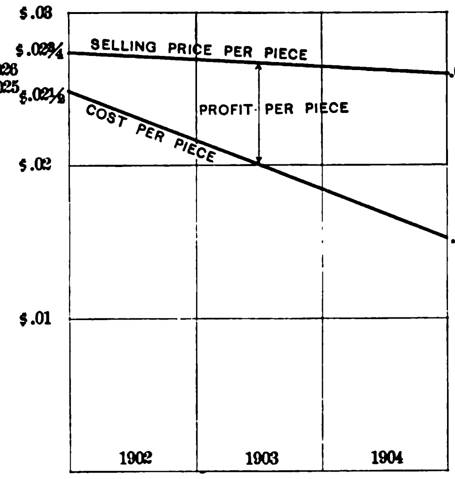


Fig. 2. Day Work.

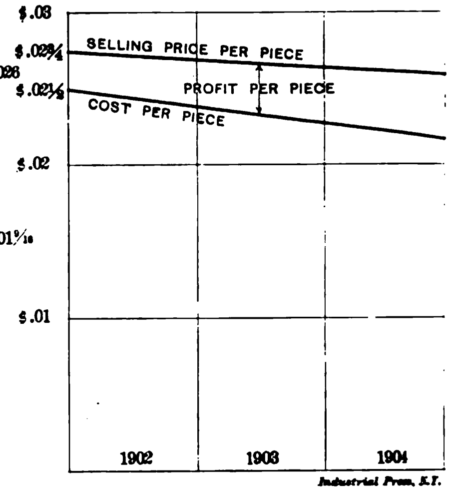


Fig. 3. Premium Plan.

First diagram shows:

Piece work with no cut in prices. Cost per piece remains constant. Selling price per piece gradually declines. Profit per piece declines rapidly. Must cut prices or lose profit or customers.

Second diagram shows:

Day work with no increase of wages at end of each year. Production gradually increases because of greater skill acquired, better tools and equipment, more sanitary surroundings, etc. Cost to consumer gradually decreases and profit to employer or customer rapidly increases unless the wages of the workmen are raised periodically.

Third diagram shows:

Compromise between *piece work* and *day work*. The wages per day are nominally the same but actually are gradually increasing. The profits per piece to employer or customer may be constant but are more apt to be slightly on the increase as shown above.

Fourth diagram (below) shows:

L M shows number of pieces per day resulting from a certain uniform effort. *A B C* shows daily earnings on *piece work* with no cut in prices. *A B D E F G* shows daily earnings on *piece work* with cut in prices. *A O* shows daily earnings on *day work* with no increase of wages. *A I D J F H* shows daily earnings on *day work* with increase of day pay at end of each year. *A D F K* shows daily earnings on *premium system* with no increase of day pay and premium equal to 1-3 of day pay. That is *O K* = 1-3 *O O*.

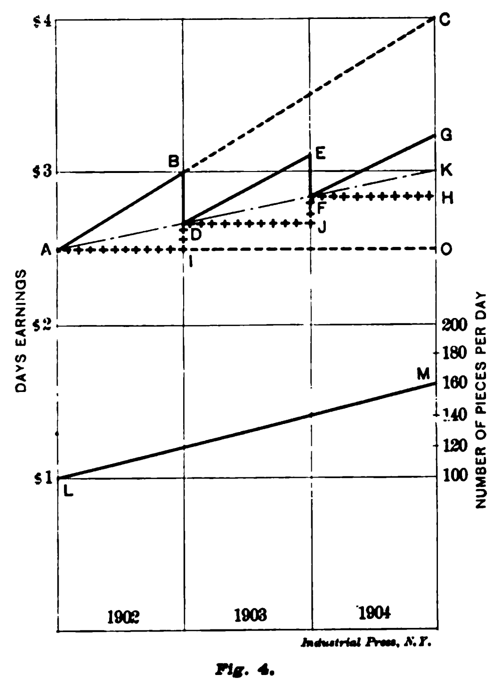


Fig. 4.

* * *

AN ODD JOB.

E. N. L. writes: Some years ago a job came to my shop, a repair and machine shop, which several other shops had undertaken to do but failed. It was to cut a thread of four to the inch on the flat or face side of a 15-inch disk or faceplate. I simply constructed a bearing and bolted it to the back of one of my lathes, at right angles with the spindle. I also bolted temporarily a miter gear on the lathe faceplate and one on the spindle at right angles, and to which the face plate requiring the thread was fastened. It will readily be understood that by this means the rest of the operation was an easy matter.

LETTERS UPON PRACTICAL SUBJECTS.

A USEFUL AND INEXPENSIVE DRILLING JIG.

Editor MACHINERY:

The sketch represents a type of a drilling jig containing features that merit the attention of the jig designer. It may not be new to some, but on the other hand I have seen expensive and complicated jigs used where one of this type

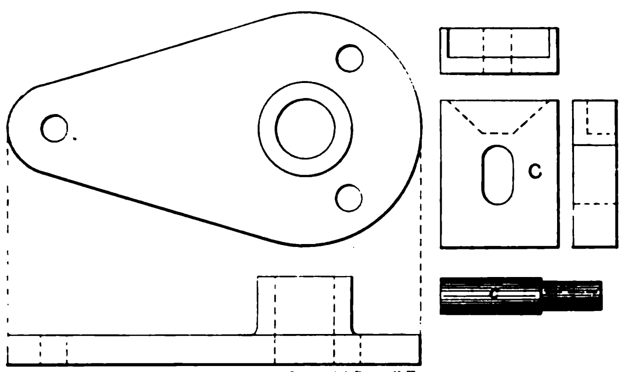


Fig. 1.

would have done as well. In our shop this type has reached a high state of development, due to conditions that favored the adoption of a cheap and quickly made jig, namely: A constantly changing product, the few pieces to be drilled and the fact that the jigs are always wanted in a hurry. In designing jigs under these conditions, the problem resolves itself into building a cheap jig and not accumulating a large number of useless patterns.

Fig. 1 shows the piece to be drilled. The plan and side views of the jig, with the work in position, are shown in Fig. 2, which shows sketch of the jig bottom side up. A cast-iron

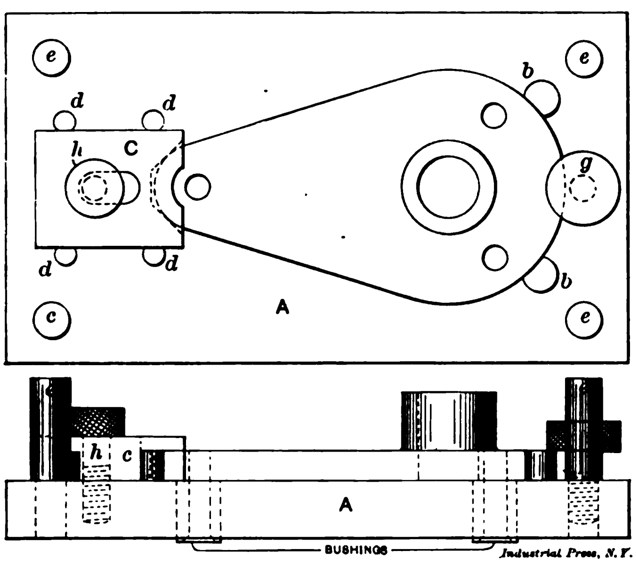


Fig. 2.

plate *A* is used, in which the required number of holes are drilled for the insertion of hardened bushings, and there are two locating pins, shown in the plan view at *b b*. *C* is a locating and clamping plate which is kept central by the four guide pins *d*. The V in the clamping plate locates the work in a central position, and as the plate also extends over the top of the work and clamps down upon it, it holds the work securely in place.

The work is bolted to the plate by the screw *h* on one side and by screw *g* on the other. The four legs *e* are shown in Fig. 2. The oblong hole in the plate permits the clamp to be moved back far enough to get the work in and out of the jig.

Large size plates, all planed up, are kept in stock so that pieces of the required size can be readily cut off when needed. This jig is very accurate, as with it the work can be brought close to the plate.

Philadelphia, Pa. LOUIS MYERS.

FILING HARD CAST IRON WHEN RED-HOT.

Editor MACHINERY:

While reading the note on page 148, of the January issue, relative to the use of sulphur for softening hard cast-iron so that it may be readily drilled, another blacksmith's trick was called to mind which may be of interest to many readers, although it is an old scheme and one probably generally known by blacksmiths, if not by most machinists. It is for readily filing cast-iron which is too hard to be filed in the ordinary manner. Such iron may be readily filed when red-hot, and the amount of metal that can be removed in a short time in this way, using a coarse rasp, is quite surprising.

I first saw this kink used twenty years ago or more, while in a country blacksmith shop. The blacksmith was fitting a pair of new cast-iron shoes to a farmer's sleigh. The new shoes were of a considerably heavier pattern than those they replaced, consequently they projected considerably below the enlarged end of the wrought iron strap which passes up over the nose of the sleigh runner. To prevent the ends of the new shoes digging into the snow and also to make a neater job, it was necessary to remove about three-fourths inch of metal from the forward ends of the shoes, tapering back three or four inches to nothing. To file them cold was out of the question as they were very hard and brittle, being on a par with the iron commonly used in window weights and plow points. Being so hard and brittle it was also quite impossible to chip them with a hammer and chisel, so recourse was had to heating them and filing while red-hot.

The shoes were removed and heated in the forge to a full red, or possibly to almost a white heat. They were then removed and caught in a vise and vigorously attacked with a very coarse file or a fine horse rasp. Each shoe was filed down in this way in a short time, requiring, as I now remember, not more than four or five minutes for each one. I have never had occasion to file hard cast-iron in this manner, but once did try to file wrought iron while red-hot with no satisfactory result. Wrought iron is tough when hot, the same as it is at lower temperatures. Cast iron, on the contrary, crumbles readily at high temperatures, and for that reason readily yields to the file, even if it be of the hardest quality when cold. F. EMERSON.

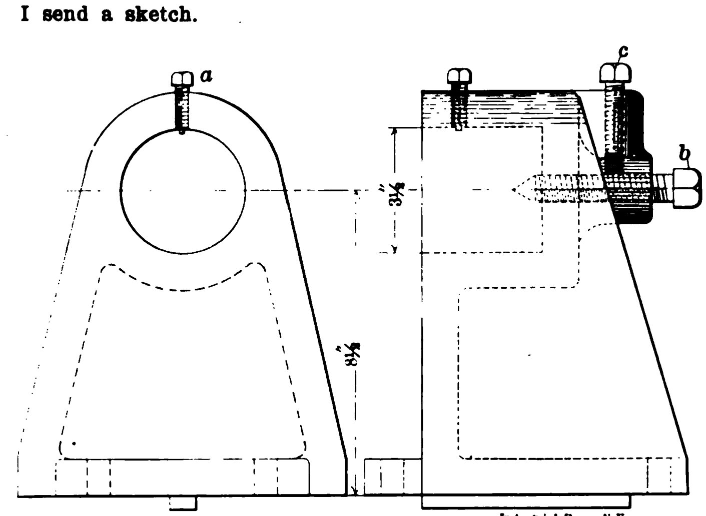
Newark, N. J.

* * *

A TAILSTOCK FOR THE MILLING MACHINE.

Editor MACHINERY:

I had a gear of 3 pitch, 48 teeth, to cut on my milling machine, and the height to the centers of my dividing head and tailstock was but 5 inches. So I made a rising block to place under the dividing head and also a new tailstock, of which I send a sketch.



Tailstock for the Milling Machine.

I found this tailstock to be much superior to the tailstocks usually provided with milling machines. The bearing was bored 3½ inches and supplied with a number of bushings that were nicely fitted to the different sizes of arbors. The

bushings, when in place, were prevented from turning by a tit on the setscrew *a* which fitted a corresponding hole in the bushing. Setscrew *b* was used only for taking the end thrust, the support of the arbor coming wholly on the bushing.

Under the end of setscrew *c* was placed a piece of brass which was threaded to match the screw *b*. This enabled me to clamp *b*, when in place, without injury to the threads. The general construction of this tailstock will be clear from the sketch. H. R. Ash.

Chicago, Ill.

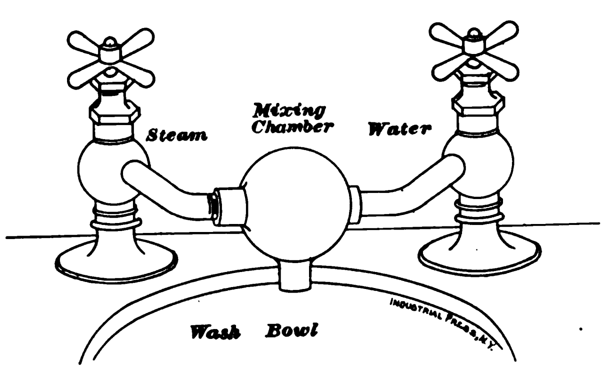
* * *

A SIMPLE WATER HEATER.

Editor Machinery:

It is easy enough for a fellow to "get into hot water" figuratively speaking, but it is not so easy to get into really hot water when he wishes to get rid of some of the shop grease and dirt on his hands in order to handle a set of plans or look over several pages of specifications.

Hot water suitable for washing purposes is not often available around the shop or even in the office, but steam is usually at hand and the accompanying sketch shows an arrangement by which live steam may be mixed with cold water as it flows



Water Heater.

from the faucet, so as to make the water in the washbowl of any desired temperature. Two faucets, one for steam, the other for cold water, are coupled together after the fashion of a double bathtub faucet, except that the connection in the middle is much larger so as to permit the steam and water to thoroughly mix before passing out into the basin. The steam pipe, if small, should not run far to the source of supply or else the steam will condense and fill up the pipe with water, cold and not always clean. W. H. Sargent.

St. Johnsbury, Vt.

* * *

EQUIPMENT FOR A SMALL BRASS FOUNDRY.

Editor Machinery:

I recently had occasion to estimate the equipment for a small brass foundry, and I send you the sketches of the plant which I designed, showing the arrangement. The building can be built of wood or brick, as desired.

Fig. 1 is a plan of the foundry, and Fig. 2 shows a sectional elevation. As will be seen in Fig. 1, the building is divided into two sections, the small one being used for an office and the larger for the foundry. In this foundry on the right are three furnaces, with a core oven built over the flue,

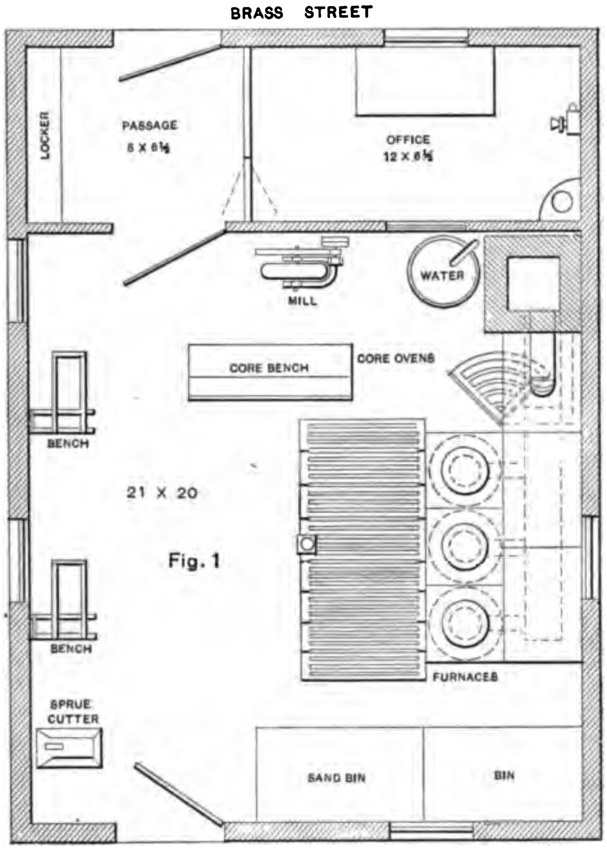


Fig. 1

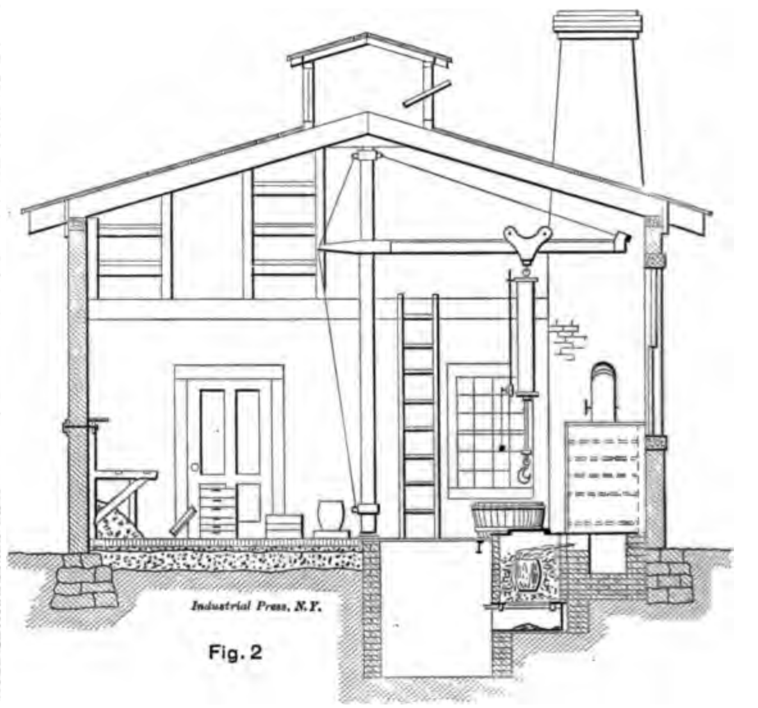


Fig. 2

Plan View and Cross Section.

arranged with a sliding damper which takes part of the waste heat through it to dry the cores. On the left are the benches. Tubs are not much used; they are considered unhandy, as with them the sand cannot be as easily handled. The sand is tempered on the floor and then thrown back against the wall for further use.

One of the features introduced was a crane, with air hoist, so arranged that it could be turned around and cover nearly the entire floor, lifting the pots of melted metal from the furnace and removing the ashes from the pit.

Over the office is a loft with shelves on one side and a space for an electrically-driven air compressor with receiver to supply air for hoisting, dusting, rapping and chipping. The electric motor when not driving the air compressor is used to run the mill for grinding the cinders.

The sketch is of a small-sized foundry, but where more room and benches are needed the foundry can be enlarged in proportion. Wm. F. Torrey.

Quincy, Ill.

* * *

SPECIAL TOOLS FOR SMALL WORK.

Editor Machinery:

The tools described herewith recently came to my notice and impressed me as being very novel. All of them are of miniature proportions, but the amount of work they are capable of turning out is surprising. The first of these is a tool for cutting steel wire pins and is designed to be used in a power press. The pins are cut from wire, No. 53 B. & S.

gage, and are 1-10 inch long. The tool is shown assembled in Fig. 1, and in Fig. 2 are the parts in detail. The same reference letters are used for corresponding parts in both Figs. 1 and 2.

A block of tool steel, *B*, planed on all sides, serves as the bottom plate and is fitted into the die dish on the press. A lever *C*, planed 1-10 inch thick, the same as the length of the pins, is pivoted to the plate at *d*, and a block *E* serves to guide the lever. It is planed out underneath, forming a shoulder at *f*, to act as a stop for the lever, and the depth of the planed portion is 1-10 inch, so that when the block is fastened to the plate the lever will slide under the overhanging part and be free from shakiness.

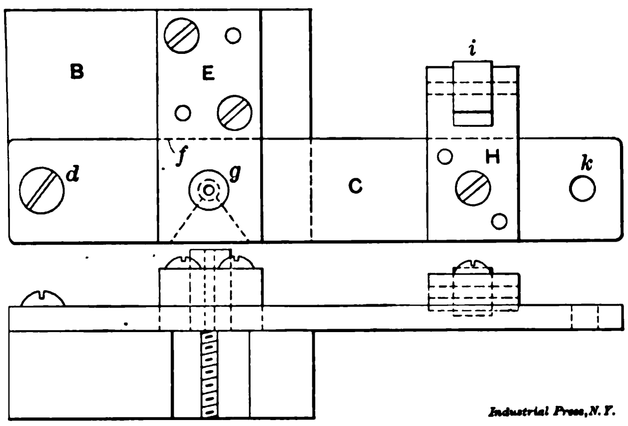


Fig. 1. Wire Cutter for Making Pins.

After the lever and block were fastened to the plate, a small hole was drilled through the block, lever and bottom plate while the lever was held firmly against the shoulder *f*. The block and lever were then removed, the hole was enlarged and a steel bushing *g* fitted in the hole in both the block and lever. A hole was drilled through the bushing in the block the exact size of the wire, and the hole in the bushing of the lever was drilled slightly larger to allow the pins to drop out after being cut. The bushings were then hardened, the one in the lever being ground flush with the surfaces of the same after it had been forced into place. The bushing in the block was allowed to project above in order that it might be forced down and reground when the cutting edge became dull. This bushing was also ground flush with the under surface of the block, so that when the latter was in place and the lever pushed in until it rested against the shoulder *f*, the two bushings would make a tight joint.

tached to the frame of the press and the other end to the lever at *k*.

The operation of the tool is as follows: With all the parts in place, the press is put in motion and a piece of wire to be cut is pushed into the hole in the bushing until it rests on the end of the screw *l*. The plunger descending, forces the lever outward and cuts the pin. The motion of the lever is continued far enough to allow the pin to slide by the screw, when the pin drops out and falls into a box provided for it. The plunger ascending, the spring pulls the lever back to receive another pin, which is pushed into place while the press is passing the center.

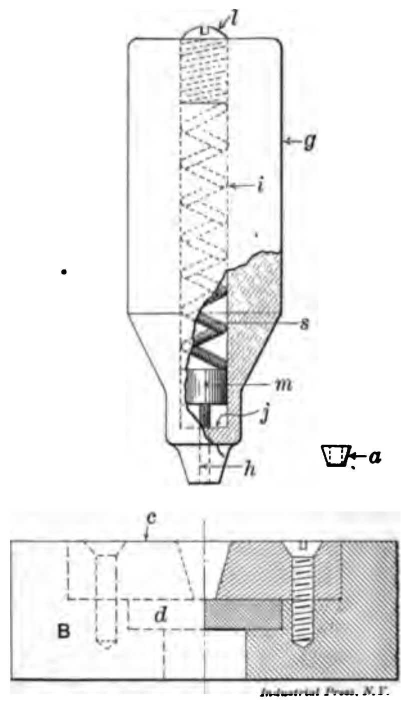


Fig. 3. Punch and Die for Making Ferrules.

The second tool is for punching ferrules, one of which is shown full size at *a* in Fig. 3. The outside of the ferrules is tapered and there is a straight hole through the center. The base *B* of the tool was turned and bored, or countersunk, to receive the bottom plate *d* and the die *c*, and a hole was drilled through the base so that the bottom plate could be driven out if necessary. The lower end of the hole in the die was made of a diameter and taper corresponding to the outside diameter and taper of the ferrule, and the punch was designed to fit the upper part of the hole, and it extends into the hole far enough to compress the metal forming the ferrule to the correct shape and height.

After the end of the plunger was turned to the right shape, a hole *h* was drilled in the small end, equal to the diameter of the hole in the ferrule, and a hole *i* was drilled from the other end down to the point *j*, and tapped for the adjusting screw *l*. The plunger was then hardened and the temper drawn very low, to prevent breaking. The plug *m* was fin-

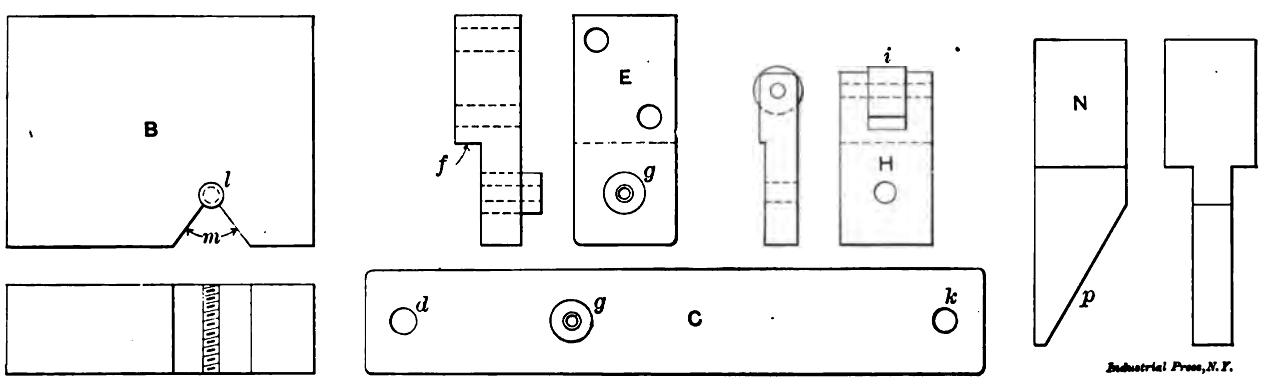


Fig. 2. Details of Wire Cutter

The small hole drilled in the bottom plate to correspond with the hole in the bushings was then enlarged and tapped for the screw *l*, which was made of steel and hardened and ground even with the top of the plate *B*. The bottom plate was finally cut away as indicated at *m*, in Fig. 2.

A small block *H*, carrying a roll *i*, as indicated, was fastened to the outer end of the lever by a screw and dowels. This roll is to take the thrust of a plunger *N*, Fig 2, fitted to the ram of the press. The plunger is hardened and has a beveled edge *p*, which acts as a cam surface. When the plunger descends, this surface bears against the roll and moves the lever outward; and as the plunger ascends, the lever is returned by a spiral spring, one end of which is at-

ished, one end being turned to fit the small hole in the plunger and the other end to fit the larger hole. The length of the small part of the plug is such that when the large part or head rests on the bottom of the large hole at *j*, the small end will project through a distance equal to the length of the ferrule. This plug is continually pressed downward by the spring *s*, the tension of which can be adjusted by screw *l*.

The ferrules were first drawn of flat brass, on an arbor, through a plate on the draw bench, and were then sawn into equal lengths about 1-16 inch longer than the finished length of the ferrules. The tools having been set in a hand press, one of the brass pieces was placed on the small end of the plug, the arbor lowered, and the piece forced into the die.

When the plunger was raised the ferrule could be easily removed from the plug. This tool performed the work perfectly and withstood breakage.

In the shop where these tools were found there were a great many small holes to be tapped, for small screws like watch screws, and a sensitive power tapping arrangement was constructed like that in Fig. 4, after considerable experimenting. The sketch shows the machine about two-thirds size. The head frame is similar to the head of a small bench lathe and sets on the bench upon short legs. The head is fitted with brass bushings *c c*, in which the spindle turns. The bushings extend inward toward the center of the head and also

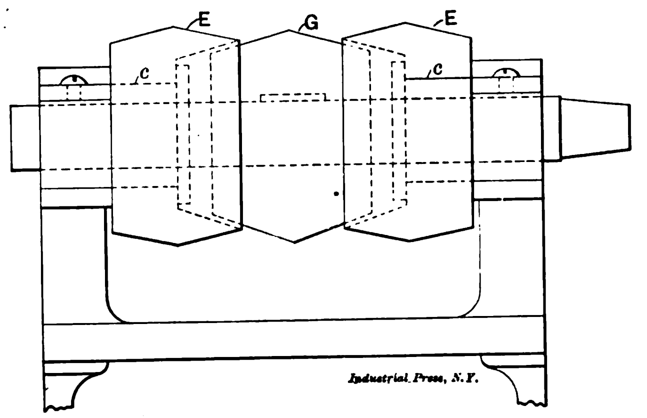


Fig. 4. Tapping Machine.

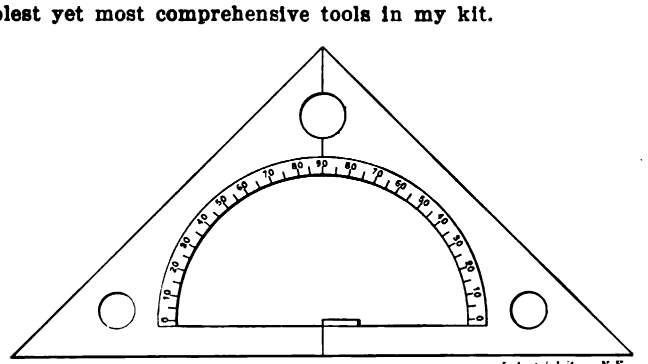
furnish bearings for the pulleys *E E*, the pulleys being retained in place by a shoulder on the inner end of each bushing. The pulleys are of cast iron and are bored taper to fit a double friction cone *G*, keyed to the spindle. The end of the spindle is turned to fit a small chuck in which the taps are held. Open and crossed belts are used, as with any tapping machine, and the design of the taper friction surfaces is such that, by pressing against the end of the tap very lightly with the work will cause the spindle to revolve and the tap to enter the work. Upon pulling backward the other pulley engages the friction and reverses the motion of the spindle. A number of these machines are now in use, some being arranged as a lathe with a sliding foot stock, having plates to which the pieces to be tapped can be attached, to guard against tapping the holes out of line. NOTROH.

* * *

AN ALL-ROUND ANGLE.

Editor MACHINERY:

The accompanying illustration is an outline of an ordinary 45-degree angle combined with an internal protractor. I made one some years ago and in use I find it one of the simplest yet most comprehensive tools in my kit.



An Angle-Protractor.

The advantage of an internal or open protractor is self evident. An outside or covered protractor, which is the usual design, reminds me of the man who was always in his own light. An open or internal protractor is never in its own light inasmuch as in no part of its 180 degrees is the area covered from center of circle to arc of protractor.

The first one of this kind I made was of Bristol board, about 3½ inches in diameter and was used in laying out the complicated angles of a bicycle frame. The angles were given in degrees and parts of degrees, the latter being estimated and I was informed later that every part came together exactly right, without any variation from the angles specified on drawings. A very accurate method was used to graduate the protractor, however.

It will be observed that holes are made in the corners of the instrument to hang it up by.

If I were to construct a more elaborate protractor I would add a vernier plate and make the protractor circle so that it could be moved some specific part of a degree; also would make it as large as convenience and utility dictate, for greater accuracy.

This angle-protractor is especially useful in laying out the angles of bevel or mitre gear blanks. I well know that some of our mathematical friends, who do everything by figures, furnish us with tables and formulas for the angles of bevel or mitre gears; but I have run against some of these men who are particular to figure the outside and pitch angles but neglect to give in their tables or drawings the cutting angles by which the gear cutter man can set over his machine to cut his wheel correctly. To set by the outside angle or the pitch angle is not right. The most essential feature in constructing bevel gears is that each be cut at its own correct cutting angle so that when cut and placed tight together, tooth into space, and an accurate try-square is used to test them on the rear ends of the hubs, they are found to be square because correctly cut.

Figures are all right if the figurer figures correctly; but if the figure man uses the wrong figures, he "don't get there" any more than the man does in attempting to get into a safe when he don't know the combination. F. W. CLOUGH.

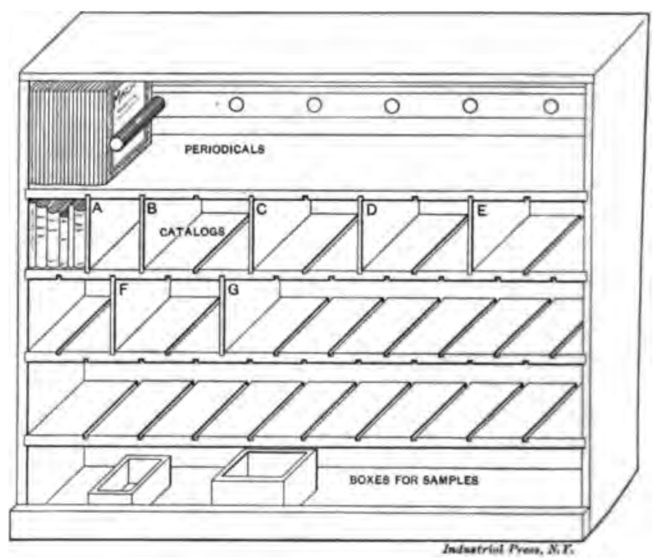
Springfield, Mass.

* * *

A HANDY CATALOGUE CASE.

Editor MACHINERY:

Catalogues being a necessary and handy reference, it is very desirable that they be arranged and kept in such a manner as to be easily found. Being myself in need of some sort of case for this purpose, I devised the one shown herewith, and it has proved a great success, enabling me to find the catalogue I want in the minimum of time.



Shelves for Catalogues.

The sketch will no doubt explain the method of construction sufficiently, but there are one or two points in connection with it worth pointing out. In the first place, it will be noticed that the various divisions are flexible, the partitions being slipped into the grooves made to receive them. These partitions are ¼-inch thick. This enables you to increase the capacity of any one letter when necessary. The distance from the front to back board of cabinet is 12 inches, and the grooves for the reception of partitions are cut to about one-half that. On the outer edge of these partitions I put pattern letters in order to alphabetize the catalogues as they arrive. I have it so arranged that all the space on the left of any partition contains catalogues, the titles of firm names of which commence with the letter on the partition.

The upper shelf has no top to it, and can be used for holding papers of various heights. These can be held in position by means of say, six wooden pins, which are made to fit snugly into the holes shown in back board. The lower portion of the cabinet can be used for boxes containing various samples, the 2-inch base board keeping same in place and keeping out dirt, etc. This board is fastened by two screws as shown, one on each end, which enables one to easily remove same in order to clean out when necessary. ROBT. A. LACHMANN.

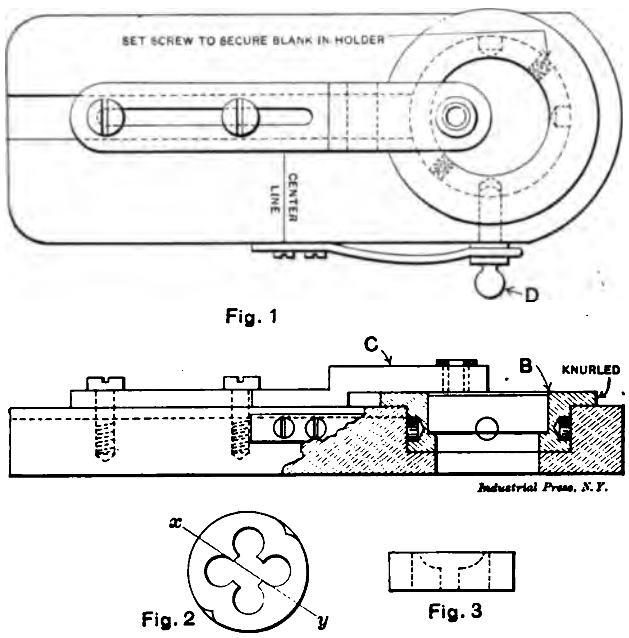
Chicago, Ill.

* * *

JIG FOR SMALL THREAD DIES.

Editor MACHINERY:

The accompanying sketch, Fig. 1, shows a jig for spotting and drilling small thread dies. The die blank is placed in holder *B*, being secured therein by the setscrews located as shown. This holder is readily rotated, as it is knurled on the edge of the flanges. It has four equally spaced locating holes, into which locating pin *D* enters. The slide *C* can be adjusted to spot holes at different radii from the center of the blank, and will locate the center hole in the blank when the mark on the slide coincides with the "center line" graduation on the holder plate. After the blank is properly spotted the holder may be removed from the plate and used to hold the blank while it is being drilled.



Spotting and Drilling Jig.

A few "kinks" about the making of these dies may be useful. The die will cut at its best when the cutting faces of the teeth are on the center line, as shown in Fig. 2. If the die strips thread off piece it is probably due to its having too much width of tooth, thereby causing too much friction; or that the cutting faces of the teeth are not on a center line, thus causing the die to drag. If the threads on the piece cut have not the correct angle the die has probably warped in hardening. Throw it away; there is no remedy. For fine threads the die should be countersunk as shown in Fig. 3, and ought not to have more than six to ten full threads, thereby reducing friction.

When a blank is tapped be sure to place lead on the opposite side from which the tap enters, as it will be found that the threads in the rear end will be truer to size and cleaner cut, and also that there will be a slight taper from the lead side, giving the threads a good clearance. Dies should be split and wedged to bring the cutting sizes up good and full.

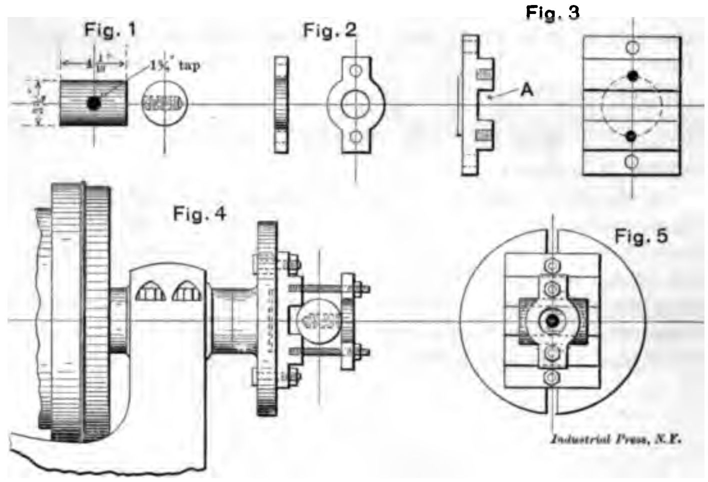
I. B. NIEMAND.

* * *

DRILLING AND TAPPING PINS.

Editor MACHINERY:

I send sketch and description of a fixture for drilling plunger bearing pins, of the Laidlaw Dunn Company's type, which I think could be used for a good many jobs of a similar nature. One of the pins to be drilled is shown in Fig. 1. It is essential that the 1⅝-inch tapped hole shall be placed exactly central with the sides of the pin and at right angles to the surface. Angle irons, used for other faceplate jobs, were first tried and later V-blocks, but without success, owing to the tendency of the pins to move out of position while being drilled and tapped; so the method shown below was adopted. A counterbore was first made in a faceplate and a casting, shown in Fig. 3, was turned to fit the counterbore, the casting being held to the faceplate by two bolts, as shown in Fig. 4.



Details of Lathe Drilling Fixture.

A groove *A* was then placed in the fixture, central with the counterbore. Into this groove the pin was placed and held in position by two studs and a strap, shown in Fig. 2. Figs. 4 and 5 show the fixture assembled with the pin in position for drilling.

With this arrangement very satisfactory results were obtained. C. W. PUTNAM.

Holyoke, Mass.

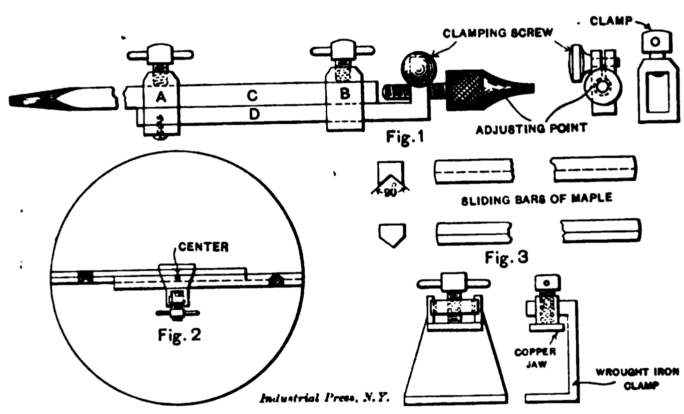
* * *

INSIDE GAGE AND TEMPORARY CENTER.

Editor MACHINERY:

Being constantly in need of an inside gage for accurately transferring measurements ranging from 18 to 54 inches, I devised the arrangement here illustrated. Its advantages are that it is very cheap to make and can be very quickly set to any size within its limits.

A piece of ½-inch square cold-rolled steel is bent up at one end and then drilled and tapped to receive an adjusting point. The end is then split with a hacksaw, and fitted with a clamping screw which securely locks the adjusting point. *A* and *B*,



Details of Gage and Center.

Fig. 1, are two clamps for holding the removable rod *C*. A small screw secures clamp *A* to the end of the rod *D*, while clamp *B* is free to slide along the rod so that it can always be clamped at the end of rod *C*. Rod *C* is made of ½-inch square cold-rolled steel rounded down at the point. Several of these removable rods are provided, varying in lengths to accommodate the work at hand. The use of the gage will be apparent to any one familiar with measuring instruments. If used with ordinary care it will detect a variation of .0005 inch (½ thousandth of an inch) or less.

The simplicity and success of this method for obtaining dif-

ferent lengths, suggested the use of the same idea for another purpose—that of temporarily finding the center of a finished hole, as is so often required when laying out work.

A glance at Fig. 2 will show how the usual hunt for a stick, a saw and a wedge can be avoided when this work is to be done. Figs. 3 and 4 show the sliding bars and clamp in detail. By having on hand a number of maple bars of different lengths, the device may be applied to any size of hole. The ends are made slightly tapering from the bottom outward and if the arrangement is set just a little larger than the hole it is to fit, it will drive snugly into place and stay there. WILFRED J. THOMPSON.

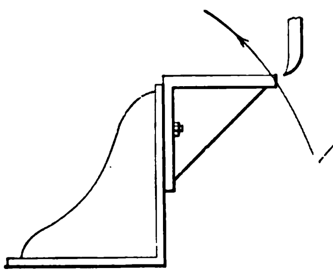
Pittsburg, Pa.

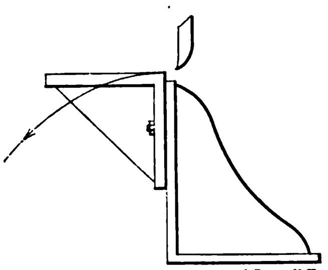
* * *

HINTS FOR PLANER WORK.

Editor MACHINERY:

In my shop experience I have often noticed that in using angle plates, on the milling machine or planer, the plate is usually placed with the broad side *toward* the cut. This is, no doubt, owing to the fact that the braces look as though they were designed to resist a pushing strain. It is very easy, however, to show that much better results will be obtained when the broad side is turned *from* the cut.

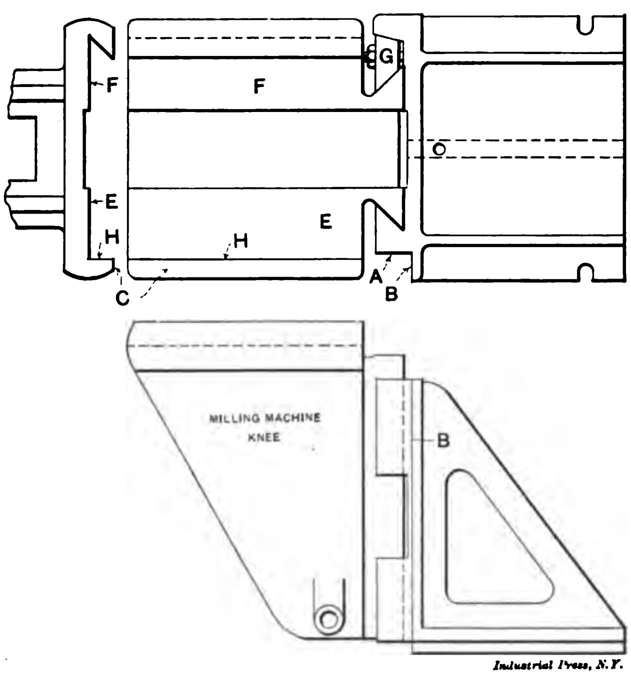




Industrial Press, N.Y.

Fig. 1. Fig. 2.

Where the angle plate is placed facing toward the cut, as in Fig. 1, it will be seen that the work is going to lift up into the tool, and is not going to let go until all of the spring has been lifted out of the angle plate. This will be repeated, up and down, continually, thus giving a rough surface to the work, or, as we say, causing it to "chatter." If the cut is very heavy, the chances are that the work does not let go, but digs in so deeply that it is torn from the plate or the



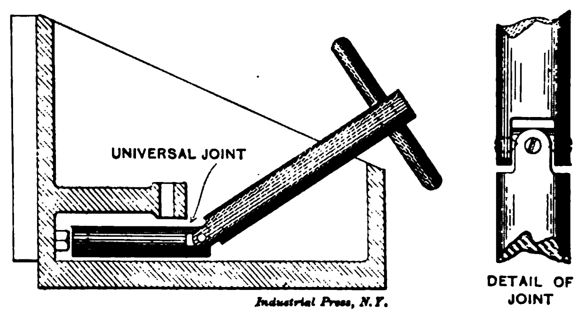
Industrial Press, N.Y.

Fig. 3.

tool is broken. If, now, the angle plate is turned from the cut, as in Fig. 2, the work will spring down, away from the tool, without any digging or chattering.

I once knew two machinists, one of whom was generally quicker than the other, yet on a certain job the slow one always beat the other just through understanding this prin-'ple and facing his angle plate the right way. I think this principle will hold in all kinds of machining. Strap or hold the work so that when it springs it will be away from the cutting tool. This will avoid chattering and spoiling work.

There is no doubt that the more accurately jigs are made, the greater will be the time saved in assembling the completed parts. It is, therefore, good policy to so construct jigs that they will prove their work before it is removed.



Industrial Press, N.Y.

Fig. 4.

A jig, shown in Fig. 3, for planing a milling machine knee, is constructed on this principle. The jig is planed at *A* and *B*, perfectly true with the surface to which the knee is clamped by the gib *G*. It will be seen that when the knee is finished on top at *F*, *E* and *C*, and down the side *H*, the work can be tested in three directions, with a large square, in order to prove that the planing is correct before removing the knee from the jig. When testing, the square is tried down the side of the jig at *A* and *B*, then the blade of the square can be tried along the side *H*.

Any machinist who has skinned his knuckles by the slipping of a wrench will appreciate the form of wrench shown in Fig. 4. It often happens that a nut or screw is in such a place that it can hardly be reached with any form of regular wrench, owing to the lack of room in which to swing the handle. A socket wrench, as shown in the sketch, can be used with convenience in a great many such places. The universal joint allows the socket part of the wrench to be applied wherever desired, while the handle, making any angle with the shank, can be operated in any position that is convenient. H. L. CAMERON.

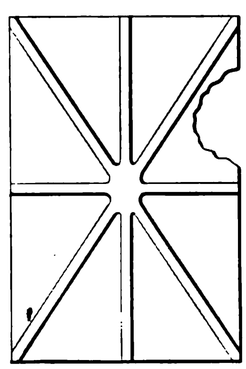
Cincinnati, Ohio.

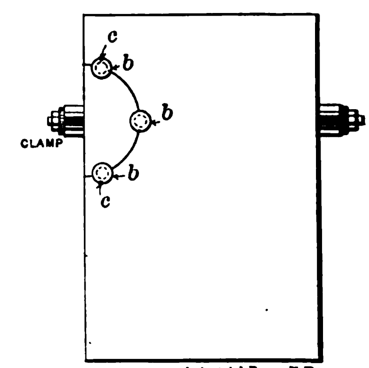
* * *

A HURRY-UP JOB.

Editor MACHINERY:

Several years ago I had occasion to patch a plate for a printing press—a hurry-up job, of course. The owner of the press thought the damage to the plate quite serious, but I assured him that we could let him have it in about four hours' time.





Industrial Press, N.Y.

Fig. 1. Fig. 2.

The break was nearly circular, as shown in Fig. 1, and near the edge of the plate. So I placed it on the drill press and cut or bored out the broken portion in the form of a true semi-circle. This was done by means of a bar supported in the spindle of the drill press and supported at its lower end by the hole in the drill press table. The bar carried a cutter of such a radius that it would sweep through a circle of the size of the place cut out. I then clamped a flat plate of suitable size on the faceplate of the lathe and cut out a semicircular piece of the right diameter to fit in the place cut out of the large plate. A nut and capscrew were clamped on the

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

CENTER SQUARE.

W. W. Cowles, Waterbury, Conn., sends us a sketch of a handy center square which is very simple and can be made at a small expense. A piece of sheet steel, about 3-32 inch thick,

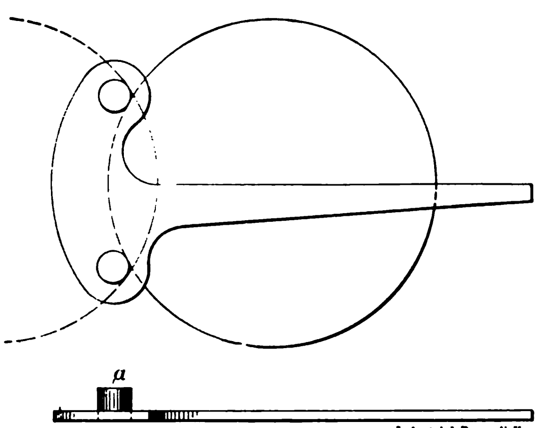


Fig. 1.

is cut out as illustrated and fitted with two pins *a*, which project below the surface and serve for guides. As will be seen this gage may be used either on the inside or outside of a circle.

FILE HANDLE.

M. H. Perrin, Vancouver, Can., writes: The accompanying sketch shows a file handle we use for filing large surfaces. It is easily made by cutting a piece of sheet iron (about 1-16 inch thick) to the required shape and bending it so as to form an opening at *A* to receive the tang of the file. The front,

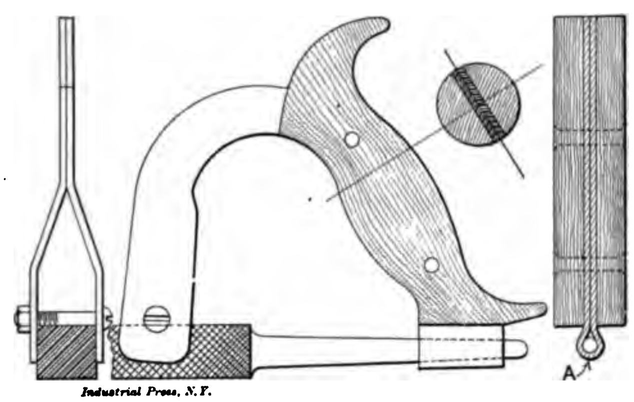


Fig. 2.

or clamp end, can be bent to fit any style of file, the file being held by a screw and nut, as shown in the sketch. The handle is finished by riveting two pieces of wood on the sides and shaping them to fit the hand.

DRILL PRESS ATTACHMENT.

E. J. B. sends a drawing and description of an attachment for the drill press for drilling holes in the sides of cored holes in castings. The cored holes were so small that there was no room to swing a ratchet, being only 2 by 4¼ inches. The attachment consists of three gears, rough cast, arranged in mesh between the two wrought iron plates *A* and *B*, as shown in Fig. 3. These iron plates, which are each 5½ by 1 7-16 by ¼ inches, are held the proper distance apart by the bushings *L* surrounding each of the machine screws *J* and the pin *K*, each end of which is bolted to one of the plates. The gear *C*, the driving gear, is driven by the shank *F*, which fits into the drill press socket. The shank, *F*, has a keyway cut in at *S*, which engages with the feather set permanently in the gear at *O*, so that the attachment may be raised and lowered as far as the keyway will allow without interruption of motion, in

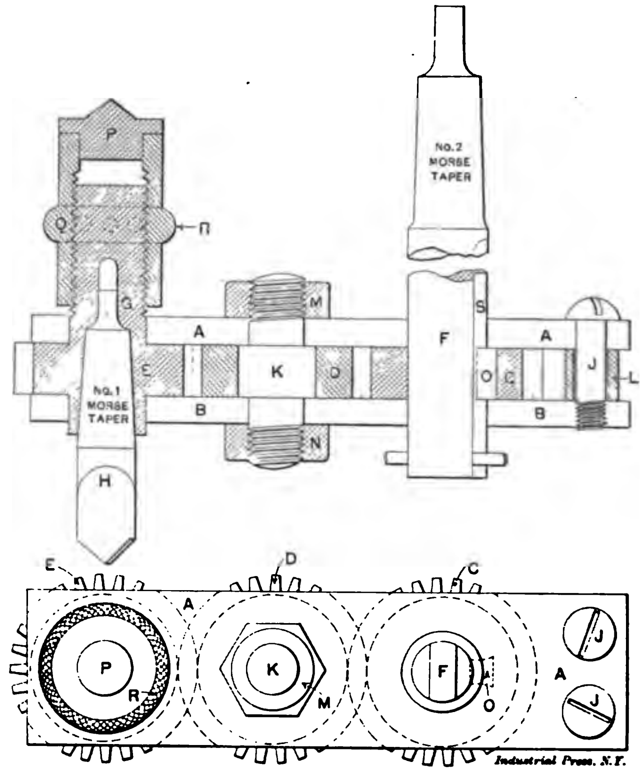


Fig. 3.

addition to the drill feed. The driving gear drives the idle gear *D*, which revolves on the pin *K*, and drives the gear *E*. This gear *E* drives the drill spindle *G*, and thus the drill *H* is driven right-handed. To give the drill pressure there is a feed sleeve at *Q*, which is fed by holding the knurled head *R*. The drill *H* is made from an old drill shank flattened out up close to the taper.

SLOTTER TOOL HOLDER.

Fred Harrison, Philadelphia, Pa., sends a sketch of a spring tool holder which he has used very successfully for roughing work on the slotter. The tool is held by two setscrews in the head of the holder, while the head itself is held in the shank of the holder by a forked joint and pin. The back sides of

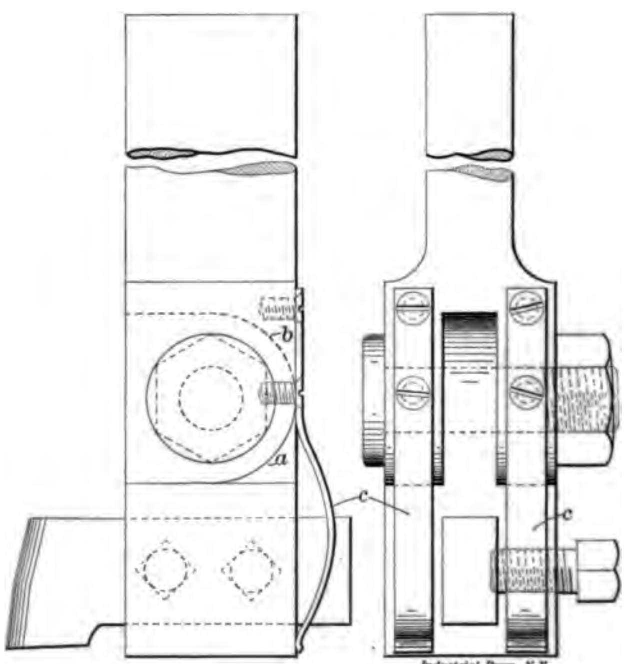


Fig. 4.

the fork are rounded off at *a* and the back side of the tongue on the head is rounded off at *b*. This allows the head, with the tool, to spring back on the return stroke. At the end of the return stroke the springs *c c* return the tool to working position.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

PIPE WRENCH.

A neat pipe wrench, shown in Fig. 1, is manufactured by the Frank Mossberg Co., Attleboro, Mass. It is 6 inches long and weighs but eight ounces, yet will take any size pipe or bolt from 1/8 to 3/4 inch in diameter. The cut shows the principle of the wrench so clearly that a description is scarcely necessary. In pulling on the wrench the jaws tend to crowd

Fig. 1. Pipe Wrench.

together and grip the pipe and hold it firmly, and in reversing the motion the wrench releases itself. The jaws and handle are drop forgings handsomely polished. The design is extremely simple for an adjusable wrench, consisting of but three parts—the two drop forgings and the pin.

BEVEL PROTRACTOR.

The Athol Machine Co., Athol, Mass., have just brought out a new bevel protractor, shown in the cut, Fig. 2. The blade swings 90 degrees between the frame plates and is held in position by a thumb nut and a screw operating upon a hooked coupler in the indicating arm. The protractor is made

Fig. 2. Protractor.

of thin tool steel so that when no square edge is available lines can be accurately taken from a drawing and transferred to the work by the use of this tool. It is a very handy tool for draftsmen, and is made in two sizes, 9 and 12 inches, with one or two blades, as desired.

MACHINISTS' VISE.

A small vise for toolmakers' and machinists' use has been brought out by the Hopkinson Machine Works, 23 Taylor St., Springfield, Mass. The jaws are 2½ inches wide, one inch deep and open 2½ inches. The entire length is 6 inches and the weight, 4½ pounds. The vise is thus light enough to be

Fig. 3. Small Vise.

used on the sensitive drill press or the speed lathe and it is strong enough to hold work without slipping. The movable jaw is clamped to the T-slot in the base by means of a bolt and is adjusted by a screw in the follower plate. The follower is held by two pins fitting into holes in the base and can be quickly set in the desired position.

BENCH TAPPING MACHINE.

Mr. H. A. Tuttle, Stamford, Conn., has recently patented and is manufacturing a new bench tapping machine, known as No. 1 A, designed especially for rapid, accurate work. The capacity ranges from a No. 2 to a No. 14 tap. It has a swing table with a range of adjustment of 4 inches, which adjustment can be increased by lengthening the column. The work is held in position on the table, the tap being operated to and from the work at will either by means of a foot lever or a hand lever. The machine can be set to tap only to the required depth, which prevents breaking taps in blind holes.

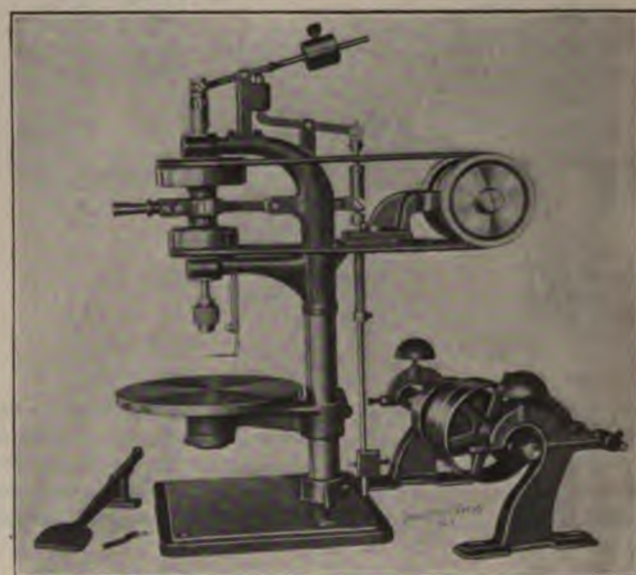


Fig. 4. Bench Tapping Machine.

The machine has an adjustable stripper to prevent work being raised from the table, and its base is finished, giving greater range for jig work. The tap spindle is driven by an endless belt from a shaft having a two-speed cone on the rear of the machine, the belt running over an idler in line with the cone pulley at the rear to give the opposite motions to the friction pulleys. The weight counterbalances the chuck and chuck spindle, which has a free movement through a hollow spindle driven by the friction pulleys. The reverse pulley is small and releases the tap rapidly. The weight lever, being raised by a compression spring plunger at the rear of the bracket, starts the tap and prevents stripping of the thread in the work. This spring may be so light that the tap will not destroy the finest thread, or the tension can be increased, as required, by a larger tap.

LATHE PAN.

The Amstutz-Osborn Co., Caxton Building, Cleveland, O., have designed and placed on the market an adjustable lathe pan of which an engraving is shown in Fig. 5. The pan

Fig. 5. Adjustable Lathe Pan.

is entirely of metal and hence is fireproof, and is so designed that the brass and iron chips may be kept separate. The framework may be adjusted to bring the pans at any point between 20 and 28 inches from the floor and it is built in

this hammer enable it to produce work much more rapidly than formerly. It is made in six sizes for chains of 3-16 to ½-inch stock.

ELECTRICALLY DRIVEN SHAPER.

The engraving, Fig. 8, shows a heavy traveling head shaper with two heads, as built by the Cincinnati Shaper Co., Cincinnati, O., when it is to be motor driven. It is an 18-inch by 12-foot shaper and two direct-geared variable speed motors are employed, one for each head. The motors are not in place, but the brackets for supporting the motor, the gear guards and the large gear, which is driven by the small pinion on the motor, are shown for driving the right-hand end of the machine.

The machine is unusually massive, and a bearing strip is placed on the lower edge of the bed for the table aprons, giving a strong support. The automatic feeds, both for the saddle and circular attachment, are of recently patented construction, and the direction of feed can be easily changed while the machine is in motion. The machine is well adapted for a class of work that cannot be done on the ordinary type of shaper, particularly for work of the heaviest class. A machine like that in the engraving is now in operation at the plant of the W. R. Trigg Co., Richmond, Va.

NEW RADIAL DRILL.

In Fig. 9 is an illustration of a new 4-foot radial drill manufactured by the Fosdick & Holloway Machine Tool Co., Cincinnati, O. The drill has convenient arrangements for tapping, positive geared feed, and back gears on the head, bringing the greatest amount of power possible directly to the work. The reversing or tapping device is so arranged that the spindle may be started in either direction without shock or jar. The tapping lever which controls this device travels

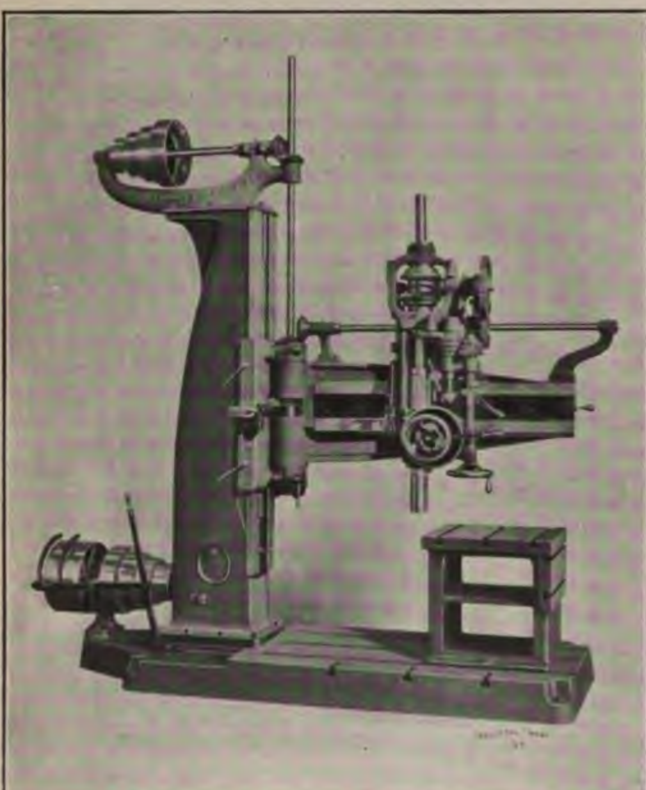


Fig. 9. Four-foot Radial Drill.

with the head and is thus always where the operator can have complete control of his machine without leaving his position. The feeds are arranged in geometrical progression.

The base is deep and has no projection, making it suitable to have the top of the base level with the floor. The column is of box section and the radial arm is exceptionally stiff, having stiffening ribs both on the upper and under side. It is supported on ball thrust bearings. The arrangement of the wheels and levers is compact, the saddle is raised and lowered by power and has a long bearing on the column. No countershaft is employed and the machine can be placed with or at right angles to the main shaft, as desired. The bevel and miter gears have planed teeth.

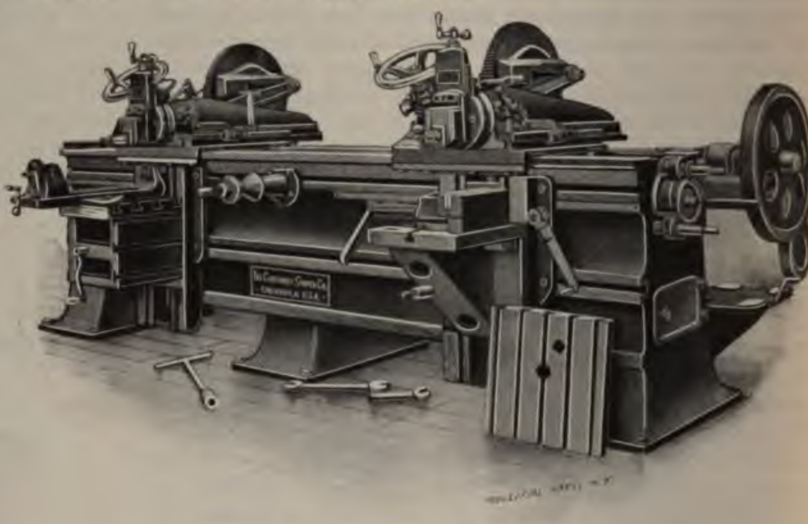


Fig. 8. Heavy Traveling Head Shaper.

The machine drills to a center of a 96-inch circle; greatest distance from spindle to base, 54 inches; diameter of spindle 1 13-16 inches; traverse of spindle, 14 inches; traverse of saddle, 39; traverse of head on arm, 32 inches; width of belt on cone, 3 inches.

COMBINED SURFACE AND DRILL GRINDER.

The accompanying illustration, Fig. 10, shows a machine intended for both surface and drill grinding. With this machine both sides may be used simultaneously. The grinder is simple in its operation; no adjustments are required to grind drills of different sizes.

The wheel for surface grinding is 12 inches in diameter by 1½-inch face, and is central over a table 10 inches wide by 18 inches in length, which can be lowered to 20 inches below the spindle, so that there is a space of 14 inches under the wheel. This drop can be secured without boring a hole in the floor for the elevating screw. The screw is geared to the handwheel shaft through a pair of accurately cut miter gears, and a dial graduated to the thousandths insures the making and reading of fine adjustments. The table is gibbed to the slide on the column and the oil holes leading to the bearings of the handwheel shaft and thrust bearing of the elevating screw are protected from grit. When desired, one side of the machine can be equipped for plain tool grinding instead of drill grinding, and can be provided with a suitable rest at the wheel.

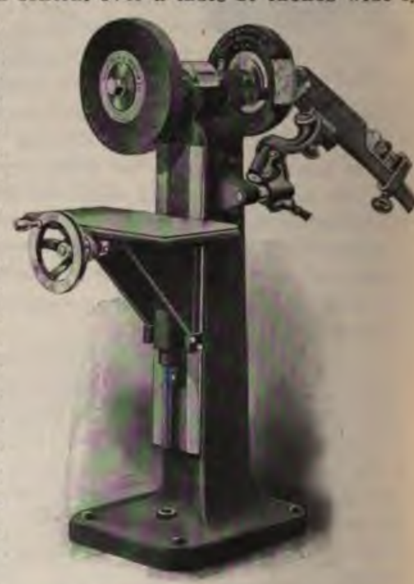


Fig. 10. Wilmarth & Morman Grinder.

MOTOR-DRIVEN SURFACE GRINDER

A full automatic motor-driven surface grinder, made by O. S. Walker and Co., Worcester, Mass., is shown in Fig. 11. This is the latest of the line of surface grinders built by this company, the others being belt driven, but fitted with the Walker magnetic chuck.

In this machine the magnetic chuck is built in the platen and arranged so that it is automatically magnetized or de-

196a

:netized as the machine is started or stopped with no :ches to turn and no screws to tighten. The operator only to lay the work on the platen and start the ma- ie.

he grinding spindle has a motor coupled directly to its end, is ring oiled and the whole has micrometer vertical istment and quick adjustment as well. The carriage and en are operated by a motor in the base of the machine and the feeds are automatic at each end of the stroke. The hine has automatic dead stop, operated by means of an trical contact when the cut is finished.

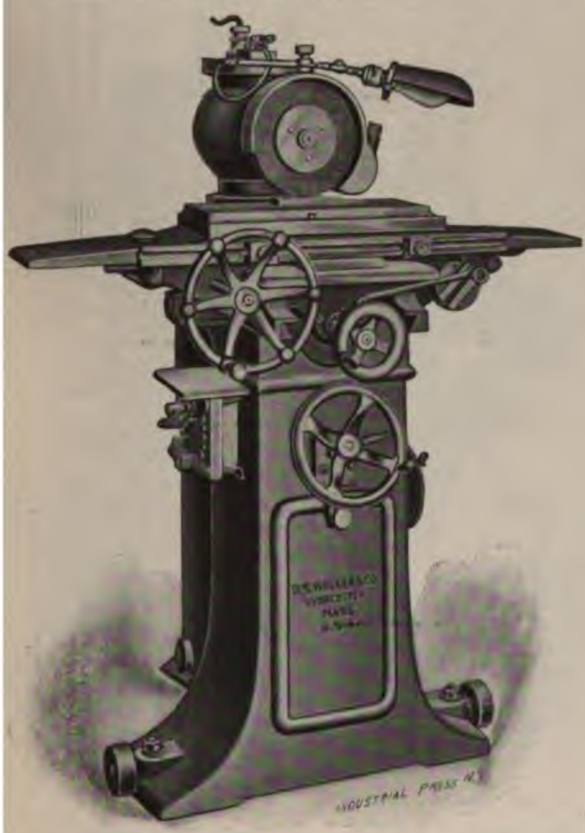


Fig. 12. Walker Electrically-driven Grinder.

he platen has variable speed and can be changed from automatic to automatic longitudinal feed without cross l, or to simple hand feed. The whole machine will auto- ically stop if the electric power fails for any reason, the tch automatically opening so that no harm can come to the ors should the current be suddenly turned on again in the , or should the machine stop in the midst of a cut at the of the day. One of the most interesting features of the :hine is that it is portable. The machine is on three els (one of them a castor) and may be readily moved from :e to place in the shop where most convenient. In this ner the machine may be transported all over a large ma- ie plant and be used on the various jobs of assembling, or in the tool room.

he only exterior connection to the machine is by means a single motor cord. The machine at present is only fur- ied for a direct-current circuit of 110 volts, the ordinary p lighting current. The No. 1 machine will surface a :e of work 15 inches x 5½ inches, and with it is furnished a :ically adjustable back rest (not shown). The No. 2 ma- ie will surface a piece of work 19 inches by 6 inches and a machine will grind its own platen.

In General.

he Boston Gear Works, 162 Purchase St., Boston, Mass., e begun the manufacture of milling cutters both for cut- ; the teeth of gear wheels and for general milling. They also prepared to furnish hobs for worm gears, cutters for ral gears, worms and for any special work. As this firm e long made a specialty of gear cutting, they have much erience in the use of cutters and in the manufacture of cial cutters for their own use, and in placing them upon market are able to utilize the results of their experience. 'he Fox Machine Co., Grand Rapids, Mich., have brought out a larger size of their hand and power feed milling machine. The smaller size was brought out about two years ago and was illustrated in MACHINERY at that time. This machine has a hand rack and screw and a power screw feed, thus combining the advantages of a light power milling machine with those of a substantial hand machine. The new size has a longitudinal movement of the table of 24 inches; a transverse movement of 6 inches and vertical adjustment of 14½ inches. The spindle boxes are universally adjustable and the power feed, spindle, etc., are the same as in the smaller machine.

* * *

STANDARD PIPE UNIONS..

A. S. M. E. COMMITTEE REPORT ON STANDARD PIPE UNIONS.

The American Society of Mechanical Engineers some two years ago appointed a committee of five members, consisting of Messrs. E. M. Herr, A. S. Vogt, W. J. Baldwin, G. M. Bond and Stanley G. Flagg, to consider the subject of standardizing pipe unions. The work was taken up in conjunction with committees appointed by the American Railway Master Mechanics' and Master Car Builders' Associations for the same purpose, and it was agreed that the A. S. M. E. committee should proceed with the work independent of the other committees who had under consideration the subjects of uniform pipe threads and square heads for bolts.

A careful examination of the dimensions of the threads in unions made by each of the principal manufacturers of such pipe fittings showed that there were absolutely no two alike, and, further, that the other dimensions were so seriously affected by the dimensions of the thread in the coupling nut that any successful attempt at uniformity in the threads must necessarily carry with it uniformity in many other dimensions of the union itself so that the committee would be obliged to take up not only the dimensions of the threads, but also those of the entire coupling union.

A careful study of the design of all makes of pipe unions now commonly used was then made for all sizes of pipe from ⅛ to 4 inches, inclusive. The investigation showed that no make of unions was sufficiently free from defects when critically examined in all the sizes to warrant its adoption as a standard, even if it had been considered advisable to do so. The committee then decided to undertake the complete design of commercial sizes of malleable pipe unions for wrought iron pipe from ⅛ to 4 inches, inclusive, in order to get a design which they could indorse as consistent and desirable as a proposed standard pipe union.

The accompanying cuts, Figs. 1, 2, 3, and 4 show the component parts of a ¾ union with the various dimensions numbered for reference in table of sizes. The table gives the dimensions of all sizes of unions from ⅛ to 4 inches, the figures at the top referring to the corresponding dimensions in the cuts of the ¾-inch union.

It will be noted that all sizes from ½ to 4 inches have the pipe and swivel ends paneled where the pipe wrench engages. This paneling is not put upon the smaller sizes on account of the increase in size of the nut and dependent parts, necessitated by putting the ribs on the ends, nor is it considered at all necessary on these sizes.

The mark "S" on the side of the union nut is suggested for a designating mark to show that a union bearing such a mark is of the proposed standard. Such a mark could be secured by copyright by the A. S. M. E. if it was deemed wise to pursue such a course. The committee recommended that this be done and all standard unions be thus designated.

A number of ½ and 2-inch unions were made to the proposed standard dimensions and tested to destruction in two ways:

1. *Tensile Test.*—A round bar of iron, threaded with proper size pipe thread, was screwed into each of the unions, and a tensile strain was put upon it until rupture occurred. Where the casting was good the breakage generally occurred from the sharp corner under the collar on the nut, or under the collar on swivel, indicating that the uniformity in strength aimed at in the design was probably affected by the sharp corner left by finishing the bottom of the nut and the collar

on swivel end. The strength seems ample, however, so no change in the dimensions is recommended. The average breaking stress of eight pieces, ½ inch, was 11,200 pounds, minimum 9,850, maximum 12,080; of 2-inch, the average was 34,450 pounds, minimum 28,800, maximum 38,600.

2. *Transverse Tests.*—Made by screwing a round bar of iron, threaded as before, into each end of union nut, these bars being of sufficient length to be supported 11 inches either side of the center of the union, load being applied on center of union nut. Breakage occurred at different points, indicating fairly uniform strength. The average breaking stress of three pieces, ½-inch, was 730 pounds, minimum 710, maximum 750; of 2-inch, the average was 7,930 pounds, minimum 7,800, maximum 8,000.

Bursting tests were also made with ½ and 2-inch unions by putting a pressure of water upon the union when fitted to piping. The pressure was gradually increased to 1,200 pounds per square inch, the maximum obtainable, with no failure except some leakage under these pressures at the joint.

In order to secure and maintain the uniformity aimed at, if the report of this committee be adopted, it will be necessary to have standard gages prepared for the finished parts, i. e., the thread and collar of the nut, the external thread and finished parts of the nose piece, and the external finished portions of the swivel. The threads for pipe connections are already established standards recommended by the American Society of Mechanical Engineers, being the Briggs standard for pipe threads.

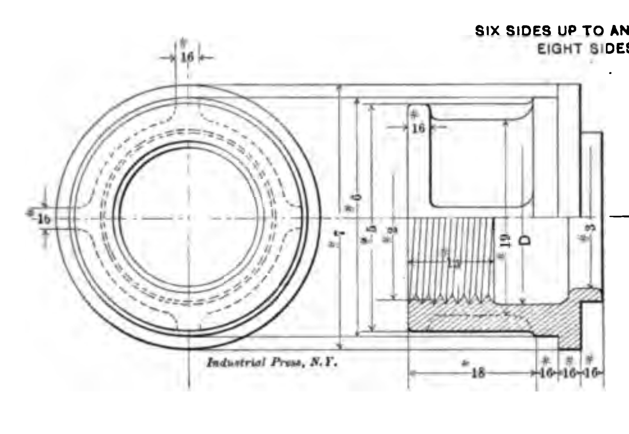


Fig 1.

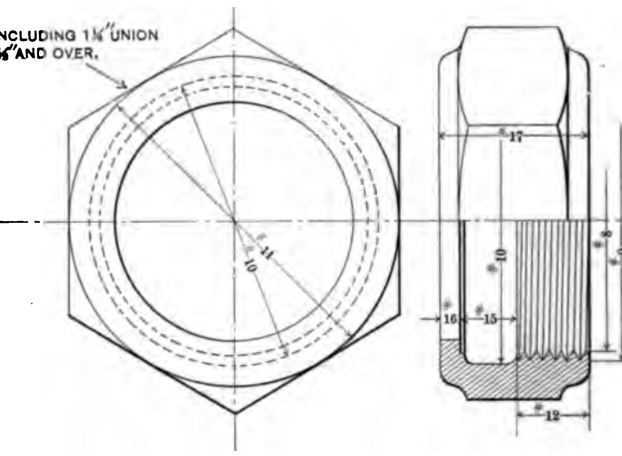


Fig. 2.

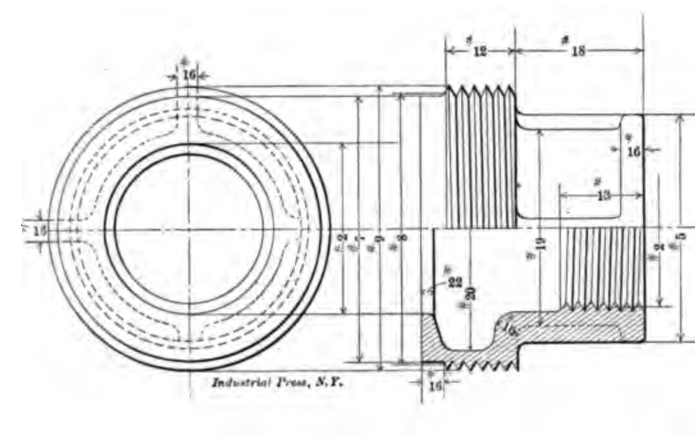


Fig. 3.

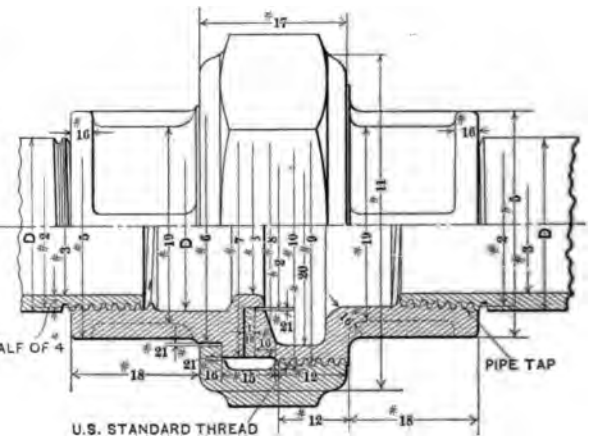


Fig 4.

Dimensions for Proposed Standard Pipe Unions.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Inches																					
⅛	.375	.270	.105	.59	.63	.78	.80	.85	.89	1.05	1.26	¼	27	.2225	.08	.5625	⅛	.59	.615	.006	.05
¼	.496	.364	.132	.76	.80	96	.98	1.05	1.09	1.29	.33	5/16	18	.2625	.10	.6925	3/16	.76	.76	.006	.06
⅜	.630	.494	.136	.90	.95	1.11	1.13	1.20	1.24	1.45	.34	⅜	18	2825	.11	.7325	⅝	.90	.905	.006	.07
½	.783	.623	.160	1.16	1.21	1.38	1.40	1.49	1.54	1.78	.40	7/16	14	.3025	.12	.8225	11/16	1.03	1.20	.006	.08
¾	.992	.824	.168	1.38	1.43	1.61	1 63	1.72	1.77	2.02	.42	½	14	.3235	.13	.8725	¾	1.24	1.43	.007	.09
1	1.246	1.048	.198	1.74	1.79	1.98	2.01	2.13	2.19	2.49	.49	9/16	11	.3625	.15	.0025	13/16	1.565	1.76	.007	.10
1¼	1.592	1.380	.212	2.12	2.18	2.37	2.40	2.52	2.58	2.90	.53	.6	11	.3825	16	1.0725	.9	1.91	2.15	.007	.11
1½	1 831	1.610	.221	2.40	2.46	2.66	2.69	2.81	2.87	3.20	.55	.7	11	.4025	.17	1.1225	1.0	2.18	2.40	.007	.13
2	2.306	2.067	.239	2.89	2.95	3.16	3.19	3.31	3.38	3.74	.60	.8	11	.4225	.18	1.2025	1.1	2.66	2.90	.008	.14
2½	2.775	2.468	.307	3.39	3.45	3.67	3.70	3.86	3.93	4.39	.77	.9	8	.5225	.23	1.5225	1.2	3.16	3.41	.008	.16
3	3.401	3.067	.334	4.07	4.13	4.36	4.40	4.56	4.63	5.13	.84	1.0	8	.5625	.25	1.6525	1.3	3.81	4.08	.008	.18
3½	3.901	3.548	.358	4.61	4.68	4.91	4.95	5.11	5.19	5.72	.88	1.1	8	.6025	.27	1.7525	1.4	4.31	4.63	.008	.20
4	4.4	4.026	.374	5.15	5.22	5.47	5.51	5.67	5.75	6.31	.94	1.2	8	.0225	.28	1.8425	1.5	4.81	5.19	.008	.22

Description Accompanying Table of Malleable Pipe Unions.

Column No. 1 in the table gives the nominal diameters of pipe.

No. 2 gives the diameter of pipe at one-half the height of full thread nearest solid section of pipe.

No. 3 gives the internal diameter of the pipe.

No. 4 gives the difference between Nos. 2 and 3 and is equal to twice the thickness of metal in pipe measured from inside line to one-half the height of thread, as specified before.

No. 5 gives the outside diameter of end of pipe union, and is taken as No. 2 plus twice No. 4 plus an arbitrary increment.

No. 6 is equal to No. 5 plus an increment varying from 0.04 to 0.07 inch. This increment was allowed for the purpose of being able to slip the nut over the upper swivel end of union.

No. 7 is No. 6 plus an amount varying between 0.15 and 0.25. This lip created is considerably in excess of what exists on present pipe unions, for the reason that we find the surface between the lip and the corresponding part of nut is often damaged, and the bearing surface, when the full strength of the man is used on the wrench, is sufficient. We assume that a man would pull about 30 pounds on a wrench, with a possibility of using less force on pipes of small diameters. For that reason we made a variation in the width of the lip, which lip, theoretically, would be uniform for all sizes of pipe. The nut itself has been strengthened to prevent the lip from deflecting upward.

No. 8 is No. 7 plus an increment varying from 0.02 to 0.04 inch.

No. 9 is No. 8 plus twice the height of the thread.

No. 10 is No. 9 plus an increment varying between 0.04 and 0.08 inch.

No. 11 is No. 10 plus one and one-half times No. 4.

No. 12 is two and one-half times No. 4, and was figured especially for bearing surface, so that the thread would not wear too rapidly when the nut is occasionally removed.

No. 13 has been assumed arbitrarily, but in all cases is greater than the length of full thread on standard pipe.

No. 14 gives the number of threads per inch in length of nut. This thread, we believe, should be United States standard form and not sharp thread.

No. 15 is taken arbitrarily, but is based on the probable requirements of manufacturers for tapping out the nut.

No. 16 is three-fourths of No. 4.

No. 17 gives the full height of nut and is equal to No. 12 plus No. 15 plus No. 16.

No. 18 is the amount of projection outside of nut.

No. 19 is No. 2 plus No. 4 plus an arbitrary increment.

No. 20 is No. 7 less No. 16, with slight modifications.

No. 21 gives the clearance at several points, as indicated in cut.

No. 22 is assumed arbitrarily.

FRESH FROM THE PRESS.

WATER-TUBE BOILERS. By Leslie S. Robertson. Published by D. Van Nostrand Co., New York. 214 8vo pages. Illustrated. Price, $3.

The matter in this book is based upon a course of lectures upon water-tube boilers, delivered at University College, London. The book is devoted to a description of a great many types of water-tube boilers and of boiler appliances. Some tables of proportions are given.

PARTS XVII. AND XVIII. OF EASY LESSONS IN MECHANICAL DRAWING AND MACHINE DESIGN, by J. G. A. Meyer, have been issued by the Industrial Publication Co., New York.

Since Mr. Meyer's death the manuscript prepared by him has been arranged for publication by his associate, Mr. Charles G. Peker, and these sections of Mr. Meyer's elaborate work on drawing and machine design are prepared with the same care and have the same high standard of the former numbers. The price of each section is 50 cents.

CAST IRON, A RECORD OF ORIGINAL RESEARCH. By William J. Keep. Published by John Wiley & Sons, New York. 225 8vo. pages. Illustrated. Price, $2.50.

This volume was prepared in response to requests that the results of the author's researches in the study of cast iron might be gathered together and presented in convenient form for reference. Mr. Keep has done much to advance the knowledge of foundrymen in the subjects of mixtures of irons, the strength of iron, methods of testing, etc. The book contains records of extensive tests to determine the physical properties of cast iron, and particular attention is paid to the author's investigations regarding shrinkage of cast iron. Decided opinions are advanced regarding the best method for founders to pursue, and it is held that he may be able to use the shrinkage test in all cases in order to determine the quality of iron. The methods of applying these tests are briefly and conveniently summarized.

POWER AND TRANSMISSION. By E. W. Kerr, Assistant Professor of Mechanical Engineering, Agricultural and Mechanical College of Texas. Published by John Wiley & Sons, New York. 356 pages. Illustrated. Price, $2.00.

As a text-book for manual training schools and schools of mechanic arts this volume will undoubtedly find much favor, as the treatment of the subject is very elementary. The book will prove valueless, however, to the engineer or to the student who is attempting to obtain a substantial education in engineering subjects. The reasons for this is that the scope of the work is so extensive that the author was able to give only a superficial treatment. While this would enable a young student to obtain a good general knowledge of power and transmission, the information would be of but little value in designing. The list of subjects is somewhat appalling for a single volume, there being eight chapters on applied mechanics and mechanism, several upon the steam engine, including compound engines and condensers; indicators, the steam boiler, etc., while pumping machinery, gas engines, water power, compressed air and hot air engines all come up for consideration.

VELOCITY DIAGRAMS, THEIR CONSTRUCTION AND USES. By Charles William McCord, Professor of Mechanical Drawing, Stevens Institute of Technology. Published by John Wiley & Sons, New York. 116 pages. Illustrated. Price, $1.50.

This treatise is an abstract of a series of lectures given to the students of Stevens Institute. It is in effect a theoretical work upon kinematics or the study of mechanical movements. It explains graphic processes for determining at any given instance the direction and velocity of motion of the point, whether that motion be constant or variable. Apparently the book is valuable more as a work to give training in the theoretical principles of mechanical movements than as a work for the engineer. This is particularly so from the fact that the pressures transmitted rather than the velocities in mechanical movements are more important for the designer, and the pressures in most instances can be determined by simple applications of the parallelogram of forces.

THE INDICATOR HANDBOOK, VOL. II. By Charles N. Pickworth. Published in London, and for sale by D. Van Nostrand Co., 25 Murray St., New York. 132 12mo pages. Illustrated. Price, $1.50.

The first volume of this treatise dwelt upon the construction and application of the indicator. Volume II. takes up the indicator diagram. There is an introductory chapter, after which follow: The diagram in detail; diagram analysis; diagrams from compound engines; diagrams from gas and oil engines; diagrams from air compressors, pumps, etc.; diagram calculations. While this treatment of the subject is prepared from the standpoint of English practice, it is a valuable work for American readers, and is the most complete treatise on the indicator with which we are acquainted.

METALLURGY OF CAST IRON. By Thomas D. West. Third edition, revised and enlarged. Published by the Cleveland Printing and Publishing Co., Cleveland, Ohio. 627 12mo pages. Illustrated. Price, $3.00.

The books by Thomas D. West upon practical foundry work have become widely known and are considered comprehensive treatments of general principles of foundry practice. This book takes up the metallurgical side of the subject, without, however, going so deeply into the subject of chemistry as not to be understood by the non-technical reader. Foundry mixtures, physical tests of iron, the manufacture and use of coke, the properties of ores, etc., suggest the ground covered. The author calls particular attention to the section containing a compilation of the American Foundrymen's Association tests, which are valuable by reason that each grade was poured from one ladle of iron inside of about twenty seconds, thus causing all the bars of each set to be poured at the same temperature.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

THE FRANK MOSSBERG CO., Attleboro, Mass. Catalogue of bicycle and automobile bells and of small pipe wrenches which are illustrated in another part of this issue.

THE AMERICAN BLOWER CO., Detroit, Mich. Illustrated catalogue No. 135 of hot blast apparatus, for heating shops, factories and other buildings. The catalogue illustrates the heaters, blowers, and the engines used for driving the blowers.

O. S. WALKER & CO., Worcester, Mass. Catalogue D of grinding machinery. In this catalogue are shown their new line of surface grinder, of which one is illustrated in the department "New Tools of the Month." There are also shown the Walker tool grinders, rotary chucks, etc.

THE LINK-BELT ENGINEERING CO., Nicetown, Philada. Catalogue of the Renold silent chain gear. This is the chain that has recently attracted so much attention and that has the peculiarity of automatically taking up the wear occurring on the chain and the sprocket. It is used for all kinds of power transmission.

JAS. CLARKE, JR., & CO., Louisville, Ky. Illustrated catalogue of electrically driven tools. These are small tools with motors attached, and include a sensitive drill, a shop saw of substantial design, a semi-radial drill, a tool grinder, and a neat center grinder, which can also be used for cutters and reamers.

THE WATSON-STILLMAN CO., 204-210 East 43d St., New York. Catalogue No. 63 of hydraulic valves and fittings. This shows valves as made by this company for use in connection with different kinds of hydraulic machinery, such as presses, accumulators, draw benches, etc. A great many fittings are shown, packing leathers, and other hydraulic appliances.

WYMAN & GORDON, Worcester, Mass., makers of drop forgings, are issuing some attractive circulars which can be scarcely classed as advertising matter. The two at hand contain, one a short story of James Watt and his work, with an illustration made from a bas-relief of the inventor, which is supposed to be very old; the other a short history of Matthew Bolton.

THE BILLINGS & SPENCER CO., Hartford, Conn. Catalogue of drop hammers, trimming presses, etc. The new features in this catalogue over previous editions are a new die shoe with which their presses are now fitted, a metal board guard, a Lombards lifting jack for drop hammers and a new heating furnace. The shipping weight and cubic measurements of hammers are now given, for convenience in shipping.

FAY & SCOTT, Dexter, Me. Illustrated catalogue of machine tools. These include engine lathes, from 13-inch to 32-inch swing; turret lathes, both with the turret on the carriage and with the turret in place of the tailstock; a 12-inch shaper, and an automatic spindle drilling lathe. There is also shown a universal turret lathe, having a special turret on the carriage. They have also issued a new catalogue of their patternmakers' machinery, in which are shown patternmakers' lathes in various sizes, for both the largest and the smallest work.

MANUFACTURERS' NOTES.

MR. REUBEN C. HALLETT, who has a large circle of friends through out the country, has accepted a position with the Chicago Pneumatic Tool Company's Eastern sales department.

THE CLING-SURFACE MFG. CO., Buffalo, N. Y., have published an attractive circular telling about some of the curious uses to which Cling-Surface was put at the Pan-American Exposition. It was used on belts for driving machinery in every part of the grounds.

THE NEW PROCESS RAW HIDE CO., Syracuse, N. Y., report business very good. They had an order from the British Westinghouse Electric & Mfg. Co. for 60 of their New Process noiseless pinions and add that orders from other sources are coming fast.

FLATHER & COMPANY, Incorporated, Nashua, N. H., have been organized since December 4th, to carry on the business of the firm of Flather & Company, now dissolved. The newly-organized company will collect all accounts and assume all liabilities of Flather & Co.

THE BURT MFG. CO., Akron, Ohio, have received a sixth order from the Calumet & Hecla Mining Co. for Cross oil filters, making twelve of these filters now in use in their different mines. The Burt Company receive also a large number of "repeat" orders from the larger concerns.

GEO. BURNHAM & CO. (Frank Reed, proprietor), of Worcester, Mass., have purchased the land for a shop in Hammond St., Worcester, and will begin to erect a building for their business in the spring, which will be about 40 x 125 feet. This increase in their facilities has been made necessary by a steady growth in their business and in the sales of their drills and other specialties.

THE HODGE BOILER WORKS, East Boston, Mass., a firm that was first established in 1865 by Ebenezer and James Hodge and carried on by John E. Lynch, is now incorporated under the laws of the State of Massachusetts, and has moved to a new shop, Sumner Street, East Boston, where, with increased facilities for promptly turning out marine and stationary boilers, tanks, etc., they hope for a continuance of the patronage given them in the past.

THE BUFFALO FORGE CO., Buffalo, N. Y., recently received from Wm. Garstang, superintendent of motive power at Indianapolis, a copy of a letter which he sent to the Embree McClean Carriage Co., St. Louis, an extract of which is as follows: "Our Wabash shop is equipped with the Buffalo down-draft forges. I consider them a success, especially in so far as they keep the shop free from smoke and gas. I don't believe there is a forge better adapted for the work than the one in question."

H. A. PEDRICK, formerly connected with and superintendent for the Pedrick & Ayer Co., who resigned three years ago to engage in the construction of a mining plant and standard gage railroad in South America, has returned and has started in business in Philadelphia with Mr. Charles A. Smith, under the name of H. A. Pedrick & Co. The new firm is equipped for general machine business, but has particularly in view the manufacture of certain specialties, which will be mentioned later.

THE CLING-SURFACE MFG. CO., Buffalo, N. Y., received recently a letter from the Carnegie Steel Co., Homestead Works, stating that some 12-inch belts they were using on arc machines were stretched as far as the tightening slide would allow, at which point the belts would have to be shortened. After some experimenting they adopted the Cling-Surface belt dressing, and are now running the same belts slacked up so that they sag to within about 8 inches of the tight side when loaded.

THE STANDARD PNEUMATIC TOOL CO., Aurora, Ill., announce that they are about to erect in Berlin, Germany, works for the manufacture of "Little Giant" pneumatic tools and appliances for supplying the trade in continental Europe. They add that there is a great demand for these tools in Europe, particularly in France, Germany and Holland. Mr. W. H. Tew, formerly with the mechanical engineering department of the Chicago & Northwestern Railroad, has been appointed managing director. The export business of the company during last December was 100 per cent greater than that of December, 1900.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., through the generosity of its founders and of several prominent manufacturers, are able to offer each year a few free scholarships in engineering courses to worthy and energetic young men. The scholarships for 1902 are now available, and applications from among the readers of MACHINERY will be considered. Never before was the demand so great for men with skilled hands and trained minds, and to these the doors to progress and success stand open. The opportunity here presented of obtaining gratis a technical education, with the help of instructors specially qualified in all branches of engineering, should appeal to the ambitious young man.

THE CHICAGO PNEUMATIC TOOL CO. of New Jersey is a unification of the five following companies: The Chicago Pneumatic Tool Co. of Illinois; the Boyer Machine Co., Detroit, Mich.; the Chisholm & Moore Crane Co., Cleveland, Ohio; the Franklin Air Compressor Co., Franklin, Pa., and the new Taite-Howard Pneumatic Tool Co., Ltd., London, England. The company starts with a working capital largely in excess of a million dollars. The company's executive board announce the following appointments: W. O. Duntley, Vice-President and General Manager; C. E. Walker, Assistant General Manager; Thomas Aldcorn, General Sales Agent; W. P. Pressinger, General Manager Air Compressor Department; Chas. Booth, Manager of Chicago Office, and S. G. Allen, Manager of New York Office. The company are devoting especial attention to air compressors and report the outlook very encouraging. Among recent orders received was one from the Lehigh Valley R. R. Co. for seven 500-foot air compressors.

PUNCH

CREASE HERE.

PUNCH

PUNCH

CREASE HERE.

GRANT'S

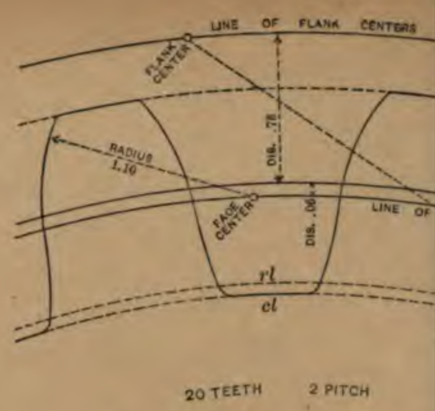


Fig. 1. Cycloidal Te

CYCLOIDAL SYST

The three-point odontograph devised B. Grant is one of the best methods gear teeth or the templates for gear t gives the centers and radii for draw approximate the actual tooth curves.

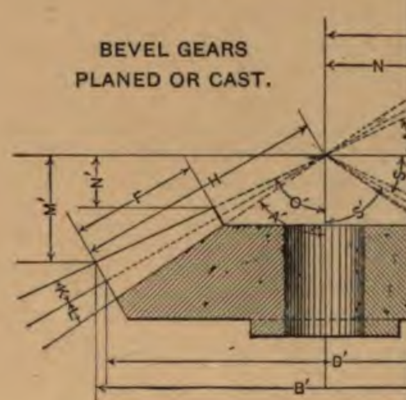
To apply the odontograph to any par teeth, first draw the pitch, addendum, cles or lines, and space the pitch line f way.

Then draw the line of flank cent tance, "dis" outside of the pitch lin centers at the distance, "dis" inside radius "rad" on the dividers, and dra from centers on the line of face c flank radius "rad" and draw all the ters on the line of flank centers.

The table gives the distances and ra exactly one diametral or one inch circ pitch multiply or divide as directed shows the process applied to a pract

FORMULAS FOR

BEVEL GEARS
PLANED OR CAST.



FORMULAS FO

Y = No. of teeth in pinion.

$$D = \frac{Y P}{\pi} = 0.318 Y P$$

FRESH FROM

WATER-TUBE BOILERS. By Leslie S.
Nostrand Co., New York. 214
The matter in this book is base
water-tube boilers, delivered at Uni
is devoted to a description of a
boilers and of boiler appliances. So

PARTS XVII. AND XVIII. OF EASY L
AND MACHINE DESIGN, by J. G.
Industrial Publication Co., New
Since Mr. Meyer's death the man
arranged for publication by his ass
these sections of Mr. Meyer's elabor
design are prepared with the sam
standard of the former numbers.
cents.

CAST IRON, A RECORD OF ORIGINAL
Published by John Wiley & S
Illustrated. Price, $2.50.
This volume was prepared in res
of the author's researches in the stu
together and presented in convenie
has done much to advance the kno
jects of mixtures of irons, the str
etc. The book contains records of
physical properties of cast iron, ar
the author's investigations regardi
cided opinions are advanced regard
to pursue, and it is held that he
test in all cases in order to dete
methods of applying these tests a
marized.

POWER AND TRANSMISSION. By E.
Mechanical Engineering, Agricu
Texas. Published by John Wil
Illustrated. Price, $2.00.
As a text-book for manual trainin
arts this volume will undoubtedly
of the subject is very elementary.
however, to the engineer or to the
tain a substantial education in en
for this is that the scope of the wo
was able to give only a superfici
enable a young student to obtain a
and transmission, the information
designing. The list of subjects is
volume, there being eight chapters
ism, several upon the steam engine,
condensers; indicators, the steam
chinery, gas engines, water power, c
all come up for consideration.

VELOCITY DIAGRAMS, THEIR CONST
William McCord, Professor of
stitute of Technology. Publish
York. 116 pages. Illustrated.
This treatise is an abstract of
students of Stevens Institute. It
upon kinematics or the study of me
graphic processes for determining a
and velocity of motion of the point,
or variable. Apparently the book is
training in the theoretical principle
as a work for the engineer. This
that the pressures transmitted rath
ical movements are more important
in most instances can be determine
parallelogram of forces.

THE INDICATOR HANDBOOK, VOL. II.
lished in London, and for sale
ray St., New York. 132 12mo
The first volume of this treatise
application of the indicator. Volum
gram. There is an introductory ch
diagram in detail; diagram analys
gines; diagrams from gas and oil
pressors, pumps, etc.; diagram calc
the subject is prepared from the
is a valuable work for American re
treatise on the indicator with which

METALLURGY OF CAST IRON. By T
revised and enlarged. Publishe
Publishing Co., Cleveland, Ohio
Price, $3.00.
The books by Thomas D. West
become widely known and are con
of general principles of foundry pr
metallurgical side of the subject, w
into the subject of chemistry as n
technical reader. Foundry mixtur
manufacture and use of coke, the pr
ground covered. The author calls p
containing a compilation of the Am
tests, which are valuable by reason
one ladle of iron inside of about twe
bars of each set to be poured at the

ADVERTISING I

We have received the following c

THE FRANK MOSSBERG CO., Attleb
and automobile bells and of small pi
in another part of this issue.

THE AMERICAN BLOWER CO., Detr
No. 135 of hot blast apparatus, for b
buildings. The catalogue illustrates
engines used for driving the blowers.

O. S. WALKER & CO., Worcester,
machinery. In this catalogue are
grinder, of which one is illustrated
the Month." There are also shown
chucks, etc.

THE LINK-BELT ENGINEERING CO.
of the Renold silent chain gear. Th
attracted so much attention and th
matically taking up the wear occurri
It is used for all kinds of power tra

JAS. CLARKE, JR., & CO., Louisvil
electrically driven tools. These are
and include a sensitive drill, a shop
radial drill, a tool grinder, and a ne
be used for cutters and reamers.

THE WATSON-STILLMAN CO., 204-210 East 43d St., New York. Cat-

pressors.

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Are good drills
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Two sizes—5-foot and 6-foot arms. Both sizes take 89 inches between Spindle and Base.

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Electric driven portable tools for heavy work

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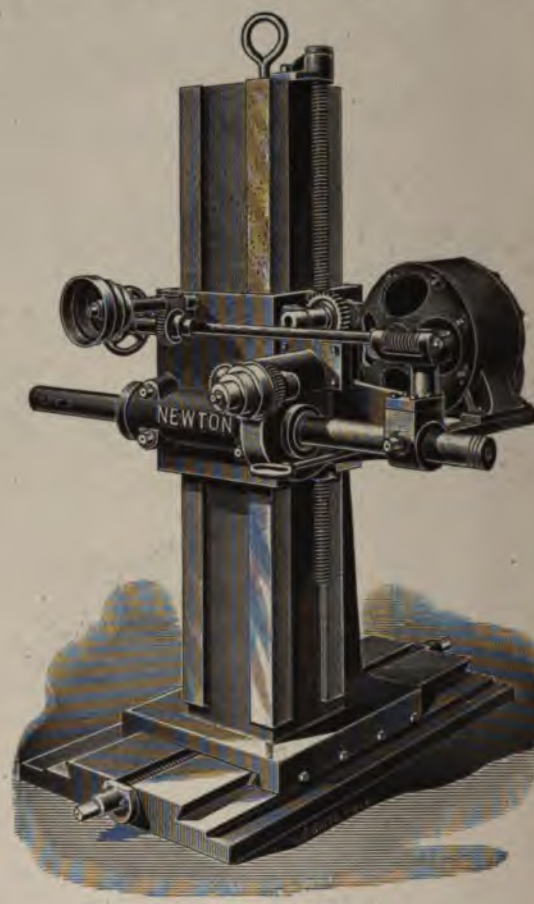
SLOTTING MACHINES,
ROTARY PLANERS,
ELECTRIC DRIVEN PORTABLE DRILLS,
MULTIPLE DRILLS.



(MACHINE NO. 186.)

No. 1 Portable boring, drilling and milling machine.

4 1-4 in. bar, 32 in. feed.

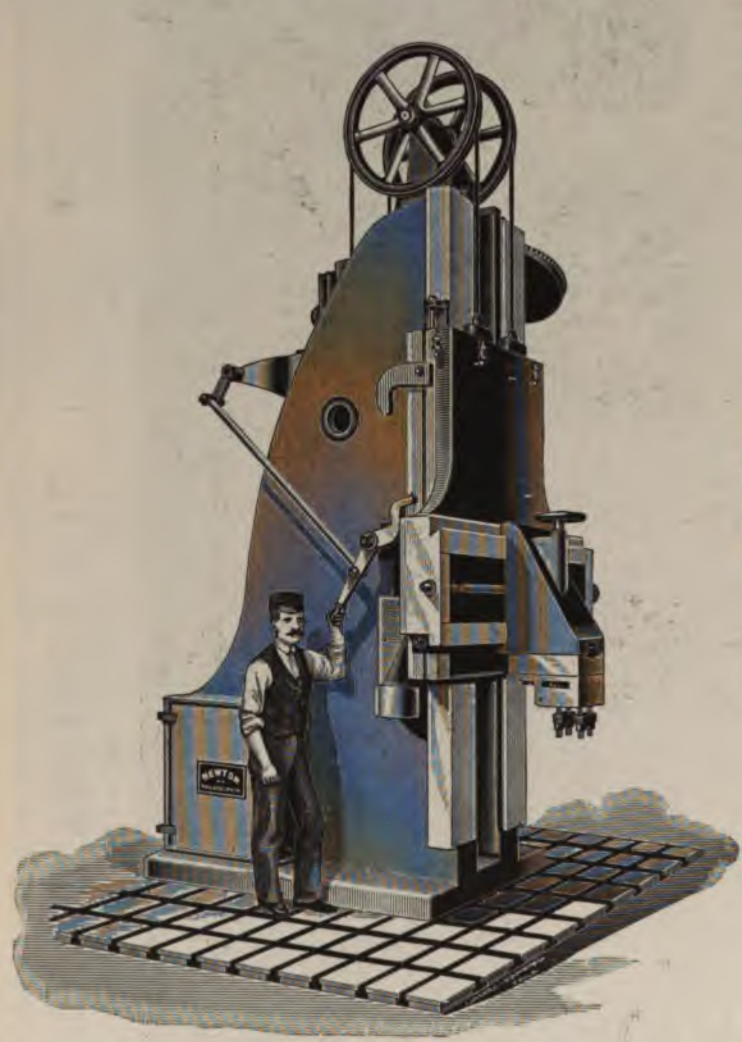
Saddle has a feed for milling of 5 ft.

(MACHINE NO. 187.)

No. 2 Portable boring, drilling and milling machine.

5 1-2 in. bar, 50 in. feed.

Saddle has a feed of 8 ft. for milling.



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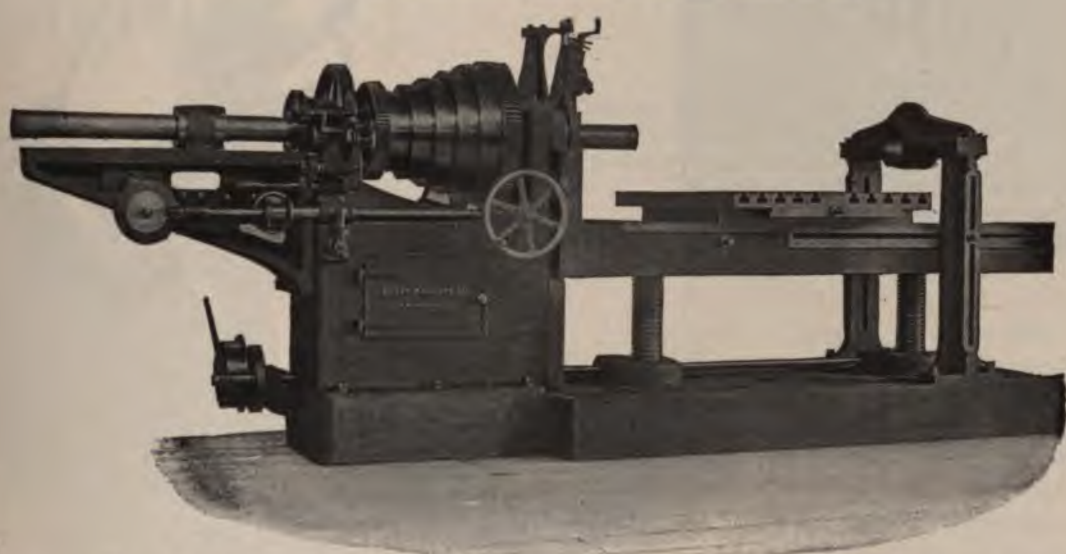

The above illustration shows the No. 3 Horizontal Boring and Drilling Machine.

IT is double back geared, giving 15 changes on the spindle, which is of cast steel, 5 in. in diameter, and has 30 in. movement through the cone with provision for 60 in. traverse when required. The steel spindle can be driven in either direction; has a full bearing through the cast iron sleeve at all times, and does not lose any of its bearing surface as it is run out, and has a quick movement by hand through a rack and pinion.

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The table is 10 feet long, elevated by two screws, worm wheels and worms which are driven by power; said table carries a saddle which has a movement parallel to the main spindle; on this saddle is a cross table 48 in. by 60 in., which has a horizontal movement at right angles. These tables can be lowered until the top table is 35 in. from the center of the spindle; and by removing the upper tables, which are 6½ in. thick, this distance can be increased to 41½ in.

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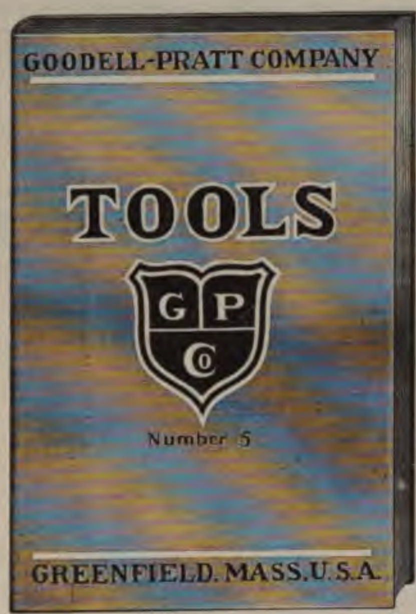

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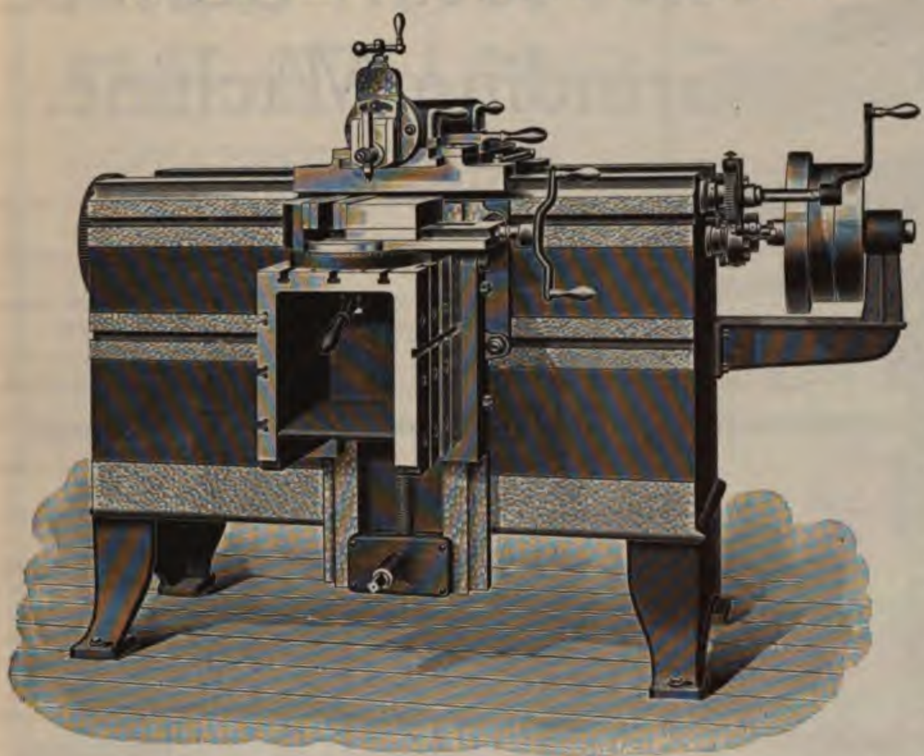

We make a small sized traverse shaper, as shown in illustration, 15″ stroke, by 36″ traverse. This shaper is equipped with our patent friction clutch driving movement, as applied to our various sizes of pillar shapers, and, in the case of the traverse shaper in hand, it equally affords perfect accuracy of stroke in length, overcomes tendency of inertia, prevalent at reversals in the case of a shifting belt machine and causing considerable loss in time, admits of stroke being changed while ram is in motion and also graduated at cutting end by aid of the micrometer adjusting stop. Down feed has graduated dial on cross feed screw. Adjustable table is our patent with three finished surfaces for work, top surface of table being 12x16″ face, table strongly webbed at bottom. Face of bed suitably finished and slotted to carry work of a nature which may not conveniently be carried on the table.

The shaper is furnished complete with improved vise, countershaft and necessary wrenches.

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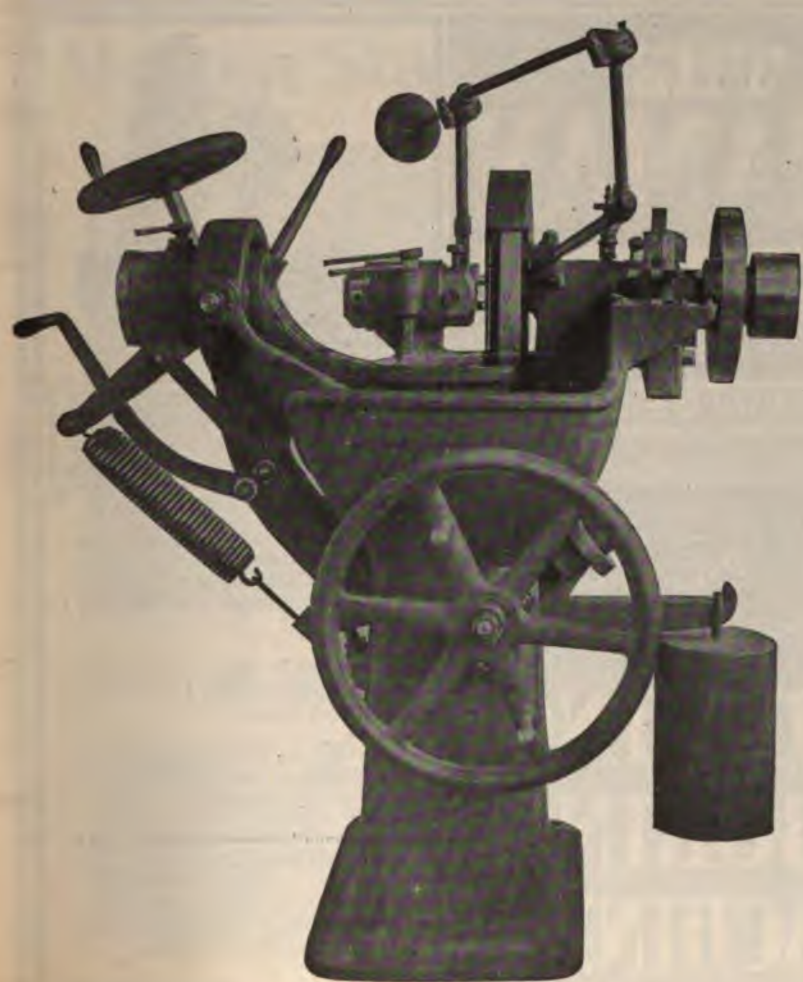

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Correspondence Solicited.

The "Ideal" Surface Grinding Machine.

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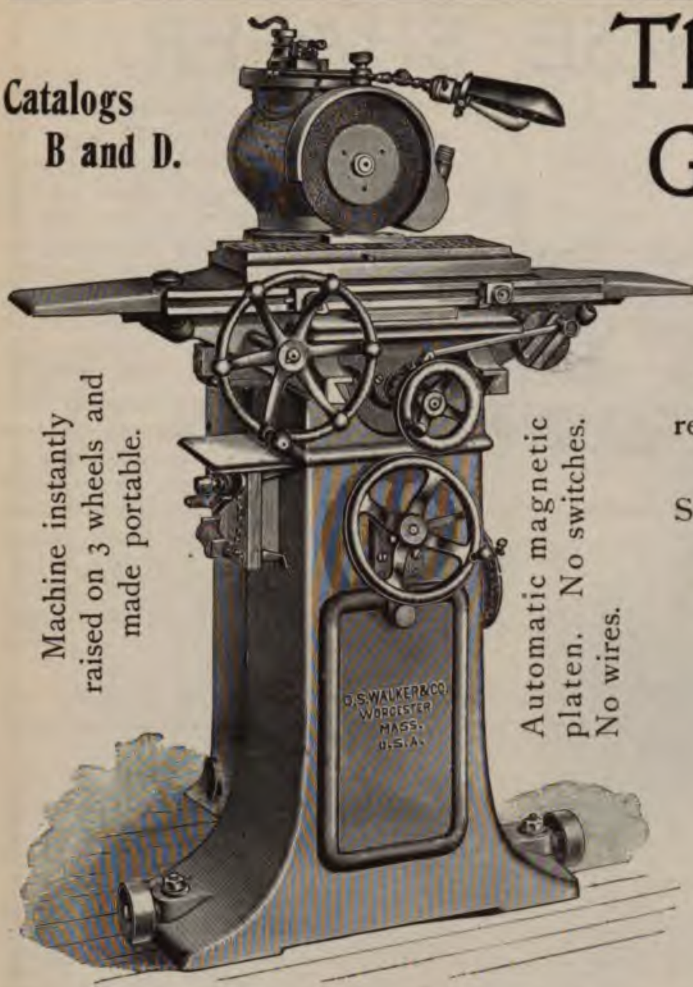

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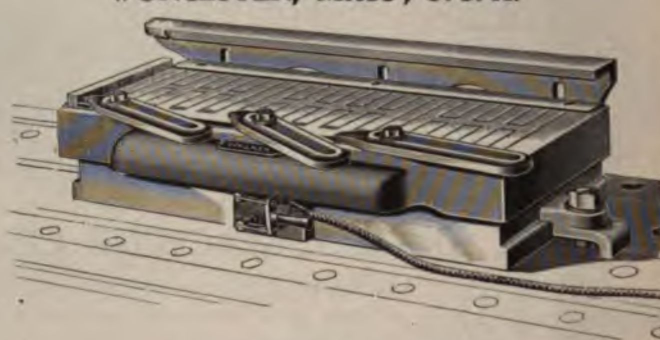
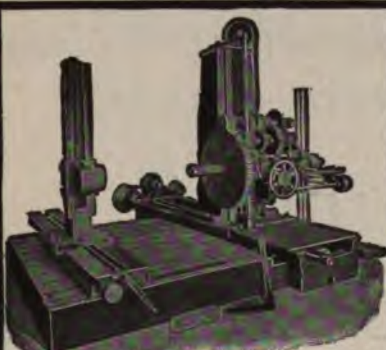


Standard Magnetic Chuck.



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One capable of operating on light or heavy work, which can be once fastened and without removing, the various operations of drilling, boring, tapping and milling be performed at any point within the range of movement provided for the spindle head, which is horizontal and vertical.

That such operations can be accurately, quickly and conveniently performed is certainly worthy of consideration when making a selection of tools for a shop equipment, or in adding to one already established.

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32 x 10, 12 & 14 Fay & Scott, C. R. & P. C. F., new.
30 to 42 x 16 & 18 ft. Lodge & Shipley, latest, new.
30 x 15 Fish, C. R. & P. C. F.
27 x 18 Lodge & Shipley, C. R. & P. C. F.
25 x 21 Harrington, C. R. & Taper.
20 x 10 Harrington, C. R. & P. C. F.
20-26 x 10 Fish compound, A1.
20 x 12 Fish compound, A1.
20 x 6 Pratt & Whitney, swivel rest, P. C. F.
18 x 8 Blaisdell, good.
50 Lathes, all makes, 12 to 20 in. swing, any length.
2 Bement Single Axle Lathes.

PLANERS.

48 x 48 x 12 Cincinnati, 2 hds, new.
41 x 26 x 15 Whitcomb, 1 hd, fair.
24 x 24 x 6 Cincinnati, 1 hd, new.
36 x 36 x 10 Cincinnati, 2 hds, new.
36 x 36 x 8 Sellers, 2 hds, A1.
36 x 36 x 8 Flather, 2 hds, new.
36 x 26 x 10 Putnam, 1 hd, good.
30 x 30 x 8 Pond, 1 hd, new.
27 x 32 x 8 Fitchburg, 1 hd, good.
26 x 24 x 6 Putnam, 1 hd, good.

SHAPERS.

32 in. stroke Prentiss frict, new.
28 in. stroke Smith & Mills, triple grd, fine.
26 in. & 21 in. stroke Prentiss, heavy pattern cran, ex base, new.
24 in. stroke Walcott, triple grd, good.
20 & 18 in. Prentiss, crank, ex base, new.
15 in. stroke Putnam, heavy pattern friction.

DRILLS.

3, 4, 5 & 6 ft. arm Bickford radials, new.
5 ft. arm Prentice Bros. radial, heavy, A1.
4 ft. arm Farrel heavy pat. radial, old design.
4 ft. arm Betts radial.
4 ft. arm Fish plain, A1.
4 ft. arm Cincinnati radial, new.
42 in. swing Cincinnati upright, B Grs, P. F., new.
42 in. Barnes upright, B Grs, P. F., new.
40 in. swing Gleason upright, B Grs, P. F., good.
25 in. Gould & Eberhardt upright, B. Grs, P., F., good.

MILLING MACHINES.

No. 13 B. & S. plain, A1.
No. 4 B. & S. plain, A1.
No. 3 Brainard plain, A1.
No. 3 Cincinnati univ., without index hds, good
No. 6 Brainard plain heavy pattern, A1.

GRINDERS.

No. 1 & No. 2 Landis univ., latest pattern, good as new.
No. 2 B. & S. 12 x 42 in., good.
No. 3 B. & S. cutter & reamer grinder, good.
No. 2 B. & S. surface, old pattern, good.

SCREW MACHINES.

2 in x 24 in. Jones & Lamson flat turret, A1.
2 in. Cleveland aut., A1.
No. 3 Hartford aut., good.
⅝ in. & ⅜ in. B. & S. aut., good.
5-16 in. Hartford aut., good.

MISCELLANEOUS.

4 in. Saunders Pipe Machine.
2½ & 3¼ in. Bar Newark Horizontal Boring Machines, new.
48 in. Bickford Vert. Boring Mill, 1 hd, A1.
52 in. Rogers Vert. Boring Mill, 2 hds, new.
1,700, 1,000, 800, 600, 400 lb. Merrill Fric. Board Drop Hammers.
No. 50 Merrill Air Cushion Power Hammer, A1.
20 ft. English Keel Bender Hydraulic, 2 rolls.
18 in. Swamscot Plate Planer.
72 in. throat, Allen.
39 in. Rogers & H. Vert. & Boring & Turning Mill, 1 hd, new.
24 in. throat Single End Punch, good.

Send for list of other tools.

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The following is a list of new and second-hand machinery we have in stock for immediate delivery :—

NEW ENGINE LATHES.

28 x 14 Fay & Scott Screw Cutting Lathe.
18 x 8 Silk-Anderson Screw Cutting Lathe.
16 x 8 Silk-Anderson Screw Cutting Lathe.
16 x 6 Fay & Scott Screw Cutting Lathe.
16 x 6 Blaisdell Screw Cutting Lathe.
15 x 6 Blaisdell Screw Cutting Lathe.
15 x 6 Young Screw Cutting Lathe.
13 x 10 Fay & Scott Screw Cutting Lathe.
13 x 6 Fay & Scott Screw Cutting Lathe.
13 x 5 Fay & Scott Screw Cutting Lathe.
13 x 5 Blaisdell Screw Cutting Lathe.
14 x 6 Young Speed Lathe.
12 x 6 Blaisdell Speed Lathe.
10 x 5 Blaisdell Speed Lathe.
13 x 4 Blaisdell Stud Lathe.

RADIAL AND UPRIGHT DRILLS.

36 in. Baush Radial Drill with tapping attachment.
36 in. Snyder Drill B. G. P. F. & A. S.
30 in. Snyder Drill B. G. P. F. & A. S.
30 in. Blaisdell Drill B. G. P. F. & A. S.
28 in. Snyder Drill B. G. P. F. & A. S.
25 in. Blaisdell Drill B. G. P. F. & A. S.
24 in. Snyder Drill B. G. P. F. & A. S.
21 in. Snyder Drill B. G. P. F. & A. S.
20 in. Snyder Drill B. G. P. F. & A. S.
20 in. Blaisdell Drill B. G. P. G. & A. S.
20 in. W. P. Davis Drill B. G. P. F. & A. S.
21 in. Snyder Drill B. G. Wheel & Lever Feed.
20 in. Snyder Drill B. G. Wheel & Lever Feed.
20 in. Snyder Drill Wheel & Lever Feed.
14 in. Woodward & Rogers Sensitive Drill.
One Woodward & Rogers Special S. Drill.
No. 24 Universal Miller.
No. 24 Plain Miller.
No. 20 Plain Miller.
Universal Cuttter & Reamer Grinder.
Millers Falls Hacksaw.

SECOND-HAND ENGINE LATHES.

19 x 6 Putnam Screw Cutting Lathe.
17 x 6 Blaisdell Screw Cutting Lathe.
16 x 6 Fitchburg Screw Cutting Lathe.
16 x 6 Wilhelm Screw Cutting Lathe.
19 14 x 6 Wilhelm Screw Cutting Lathes.

PLANERS SECOND-HAND.

24 x 24 x 6 Bement Planer.
16 x 16 x 2 Blaisdell Crank Planer.

DRILLS SECOND-HAND.

26 in. Aurora Drill B. G. & P. F.

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Garvin Miller, with overhanging arm.
Pratt & Whitney Milling Machine.
Lincoln Miller.
8 Plain Millers, with overhanging arms.
22 x 22 Bement Slab Miller.

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Davis Key Seater.
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1 Champion Blower.
No. 5 Sturtevant Blower.
23 Vises.
Challenge Grinder.
Hacksaw.
25 Universal Lathe Chucks, all sizes.
No. 1 Crowel Blower.
No. 2 Crowel Blower.
No. 5 Crowel Blower.
18 Speed Lathes.
Tapping Machines.
Lathe Presses.
Forge.
Brazing Tables.
20 x 6 Lathe.
11 x 22 Buckeye Automatic Engine.
6 x 10 Payne Automatic Engine.
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Ferris & Miles Steam Hammer.
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WANTED:

Second-hand Peck Lifter, to lift 800 lbs. State cash price and condition.

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Second-hand Machinery.

BORING MILLS.

42 in. Bullard, turret head.
54 in. Bement, one head.
80 in. Sellers, one head.
28 in. Gisholt, Lathe and Tools, almost new.
24 in. American Turret Lathe and tools, almost new.

LATHES.

32 in. x 10 ft. Gleason, double back gears, power angular feed in compound rest, 30 in. chuck; almost new.

PUNCHING PRESSES.

2—Heavy Geared Punching Presses.

PLANERS.

48 in. x 48 in. x 18, four heads.

Marshall & Huschart Machinery Company,

62-64 South Canal St., Chicago, Ill.
119 Bank St., Cleveland, O.
319 West Fourth St., Cincinnati, O.

Second-hand.—In Good Order.

1—60-inch two-tool, boring mill, Niles.
1—108-inch one-tool, boring mill, Niles.
1—60-inch x 21 ft. engine lathe, New Haven.
1—57-inch x 16 ft. engine lathe, Putnam.
1—60-inch two-tool pulley turning and boring lathe.
Bolt Cutters, each, 1, ½ and 2 inches, automatic.
1—Bolt header, 1 inch, National.
1—6-inch throat-geared punch, L. & A.
1—36-inch throat punch, new.
1—No. 3 Frech flywheel punch, 750 lb. wheel.
1—Inclinable Press, 225-lb. wheel.
1—Double blow rivet machine, Farrel F. & M. Co.
1—4 B and one 5 B vertical miller, Becker-B Co., new.
1—No. 14, ½ universal miller, Becker B Co., new.
Engine lathes 10 in. to 32 in. x 5 ft. to 18 ft., new.
2—Steam hammers, 400 to 600 pounds.

J. H. Dawson Machinery Co.

39 and 41 South Canal St., Chicago, Ill.

Second Hand Machine Tools.

72 in. x 66 in. x 12 ft. New Haven planer.
42 in. x 16 ft. 6 in. Lathe.
30 in. x 20 ft. lathe.
28 in. x 16 ft. lathe.
20 in. x 9 ft. lathe.
15 in. x 6 ft. lathe.
48 in. pulley boring lathe.
96 in. pulley turning and boring lathe.
Portable drill, rope drive.
1500 lb. Sellers steam hammer, single stand.
800 lb. Morgan steam hammer, double stand.
400 lb. Morgan steam hammer, single stand.
175 lb. Kline steam hammer, single stand.
75 lb. Bradley upright strap hammer.
12 in. Alligator shear, weight 10 ton.

WICKES BROS.,

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Wanted SCREW Machines.

Automatic up to 3 inches, must be late pattern. Good condition.

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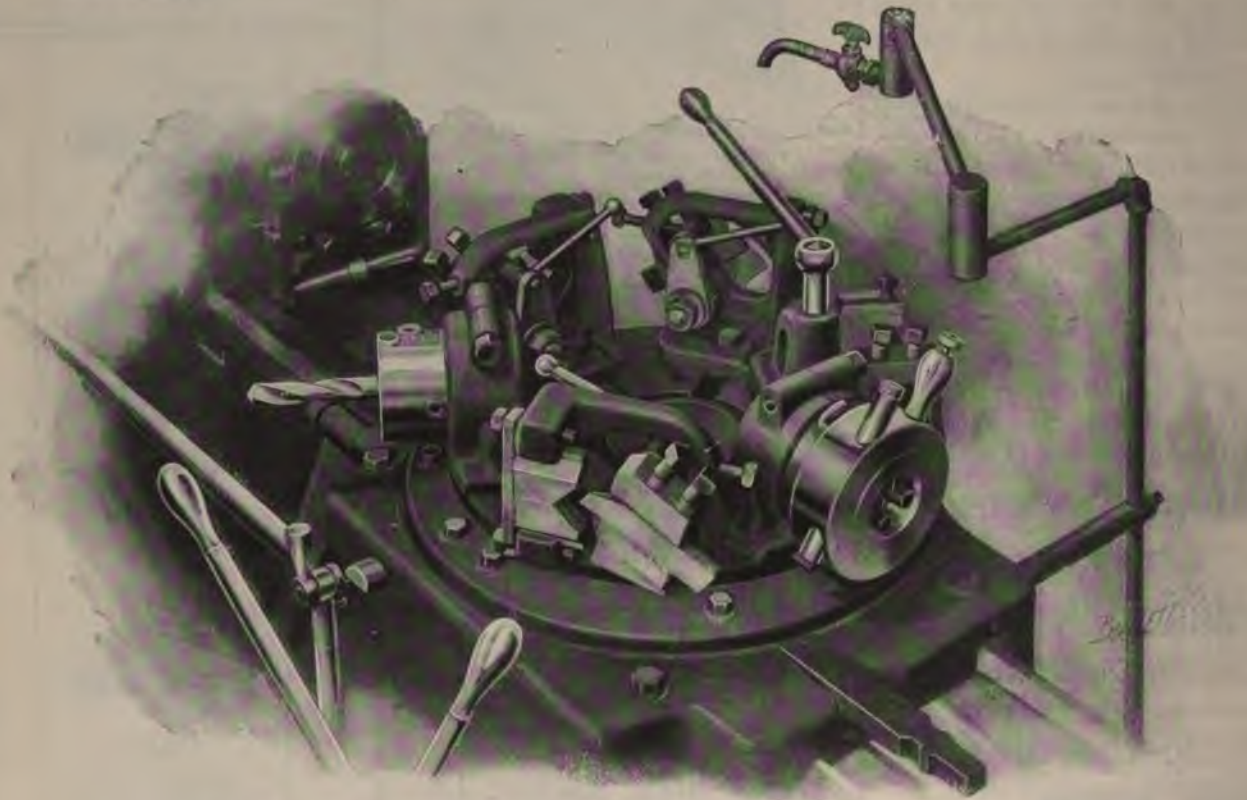
A Matter of Principle.

The principle on which the **Flat Turret Lathe** is designed is as old as the pyramids, yet apparently ignored for years by designers of machine tools. It is the simple principle that the broader the foundation and the nearer you can get to the foundation the more rigid will be the support. Overhanging parts and a small, narrow support do not give rigidity in a turret lathe any more than in a building.



This illustration shows how the tools of the Flat Turret Lathe are supported.

The turret is a flat plate extending the full width of the carriage.
It rests on a flat scraped surface on top of the carriage.
It is held down by an annular gib going entirely around the outside.
The tools are bolted to the flat plate and do not overhang.

Can you imagine anything more rigid? Is it not a substantial improvement over the usual turret, with seat of small diameter and held down by a center bolt?

Then as to the tools.—No overhanging box tools are necessary. The turners, with a single cutting tool, and each carrying its own back rest, do the work. A cut once started true will run straight. It is simply applying the principle of the shafting lathe to the turret lathe—but with many improvements.

If special tools are required, bolt them to the turret plate—no overhang with them either.

The Hartness Flat Turret Lathe is not only a turret lathe in the common acceptance of the term, but will do all kinds of lathe work, coming between ½ inch and 2 inches in diameter and up to 24 inches long. It can be used for chucking work up to 14 inches in diameter.

Where three or more lathes are used on such work there is a place for this machine. The work should be in lots of not less than six to ten pieces of a kind and the saving will average 70 per cent. We have even known it to save more than the former cost of lathe work on forged pieces, by working from the bar. Its efficiency, compared with other turret lathes, is from 50 to 100 per cent. greater.

Let us send you further particulars.

Jones & Lamson Machine Co., Springfield, Vt.

England, Scotland and Ireland Jones & Lamson Machine Co., Exchange Bldgs., Stephenson's Place, Birmingham, Eng. In Germany, Holland, Belgium, Switzerland, Austria-Hungary and Italy, M. Koyeman, Charlottenstrasse, 112 Dusseldorf, Germany. In France and Spain Ph. Bonvillain, 6 Rue Blanche, 6 Paris, France.

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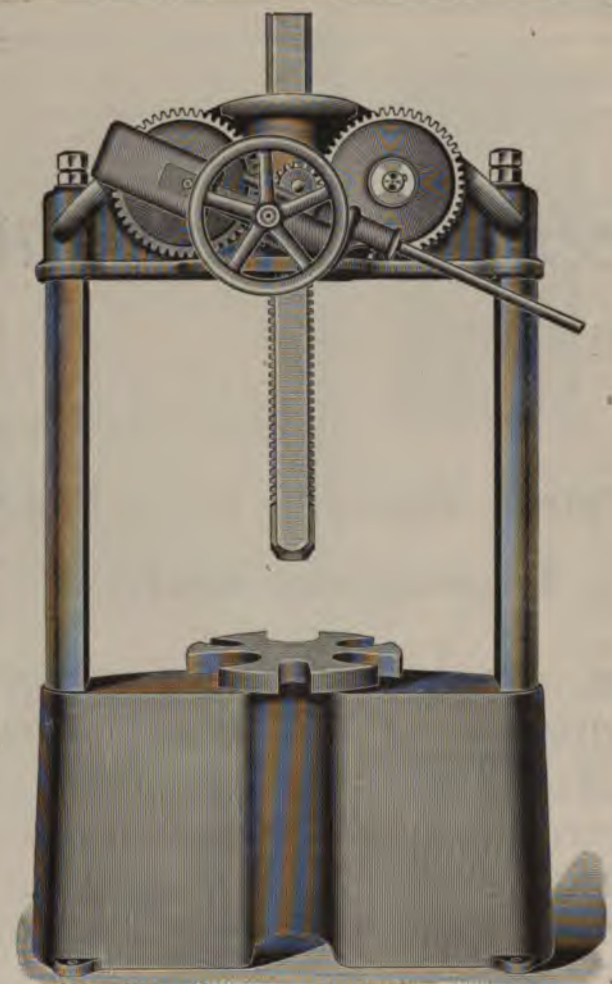
CONTENTS FOR FEBRUARY.

No. 3 Press on Lathe.



No. 8 Press.

No. 4 Press.

Eighteen tons pressure can be obtained with the aid of this press.

36 inches between uprights, 35 over plate.
Will drive 7 inch Arbors or Mandrels.

THE GREENERD

EDWIN E

308 ATLANTIC AVENUE,

THE FOLLOWING FIRMS CARRY GREENERD ARBOR PRESSES IN STOCK:

Boston : Chandler & Farquhar, Hill, Clarke & Co., Niles Tool Works Co.
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London: Chas. Churchill & Co., C. W. Burton, Griffiths & Co., Buck & Hickman.
Berlin and Vienna: Schuchardt & Schutte.

No 2 Press on stand.

No. 3½ Press on Lathe.

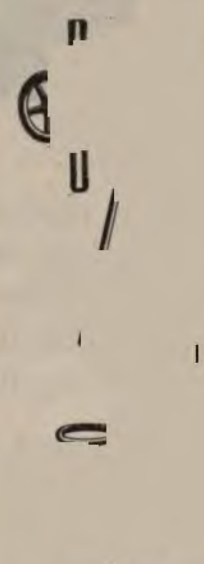
A man stood on a work-shop floor,
When all the rest had fled,
A pounding-block before him placed,
A sledge raised o'er his head.
And all unmindful of its doom,
Upon that iron block
A battered arbor feebly stood,
Too weak to stand the shock.

Time and again upon its head
The heavy sledge came down,
Until the man was positive
The job had been done "brown."
But when he took the arbor up,
They found that it was sprung,
And battered, too, quite out of shape,
On the rubbish heap 'twas flung.

The foreman then and there declared
That he would find a way
To end that wasteful practice
If it cost a whole week's pay.
And that was just the reason
(If the truth they would confess)
That they placed a trial order
For a GREENERD ARBOR PRESS.

A pounding block,—
A leaden mall,—
A ruined arbor,—
An awful "call."

No 3¼ Press on Stand.



No. 5 Press.

ARBOR

BARTLETT,

BOSTON, U. S. A.

ARE YOU IN BUSINESS FOR PLEASURE?
GREENERD ARBOR PRESSES WILL PLEASE YOU.

ARE YOU IN BUSINESS FOR HEALTH?
GREENERD ARBOR PRESSES WILL BENEFIT YOU.

ARE YOU IN BUSINESS FOR MONEY?
GREENERD ARBOR PRESSES SAVE TIME.

This Little Book

describes in detail the many special features of the

New Bickford Radial.

The New Bickford Radial.

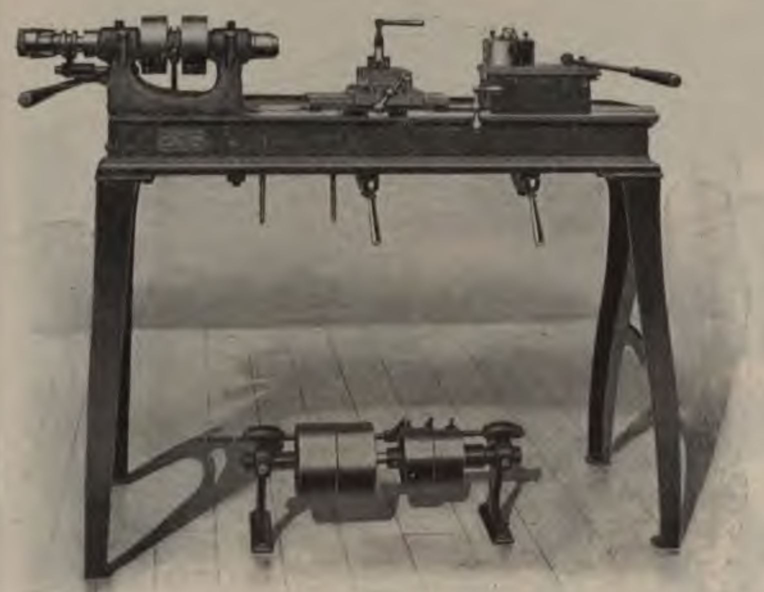
Compared with other radials this machine has twice as many speeds and from twice to four times as many feeds. It is fitted with speed and feed boxes that give instantly any speed or feed with which the machine is provided, a dial depth gauge for reading all depths from zero, and an automatic trip that operates at as many different points as there are depths to be drilled at one setting of the work.

This Book is yours on request.

The Bickford Drill and Tool Co.

Cincinnati, Ohio, U. S. A.

STOP!



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MACHINES

WHICH ARE MANUFACTURED BY :: :: :: :: ::

AUTOMATIC MACHINE COMPANY

GREENFIELD, MASS.
U. S. A.

There are Others..

AND ALL ARE MADE OF THE BEST MATERIALS, HIGHEST CLASS OF WORKMANSHIP THROUGHOUT :: ::

EVERY TOOL IS HANDY AND DESIGNED TO FILL A SPECIAL WANT

THEIR CATALOGUE TELLS ALL ABOUT THEM, TO BE HAD FOR THE ASKING :: :: :: :: :: :: :: :: :: ::

Multiple Spindle Drills.

Our Multiple Drills are built with great care and good workmanship.

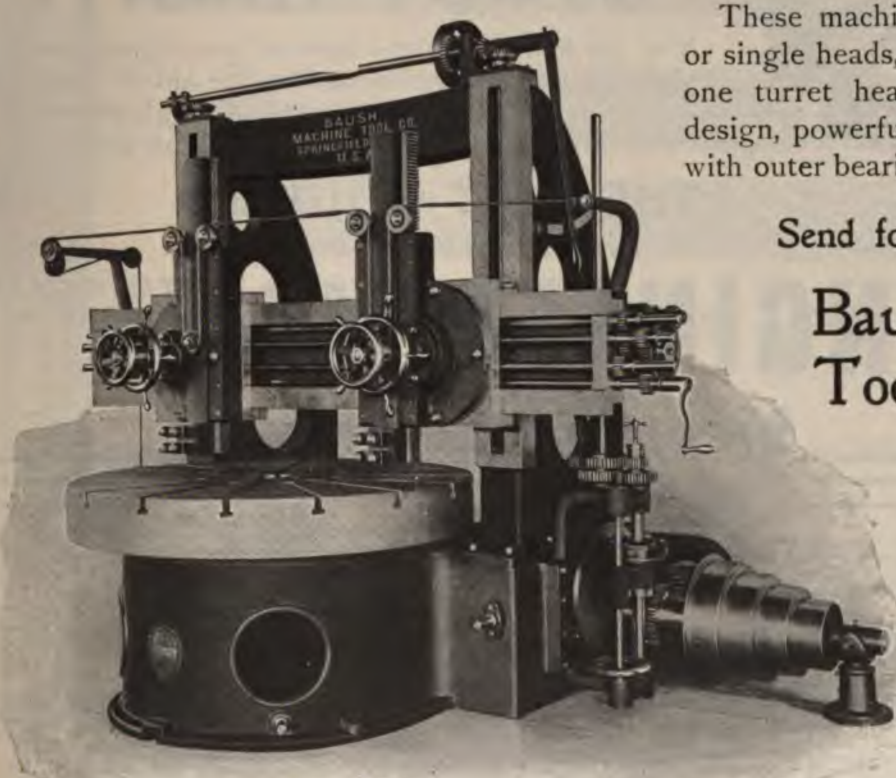
Would like the manufacturer to look over his work and see if he cannot find a place where he can put one or more of our Vertical or Horizontal Machines in his shop to some advantage.

Others do, why not you?

We build these machines with 6, 8, 10, 12, 14, 16, 18, 20, 22 and 24 spindles, and to take in most any required layout.

Full line of Radial Drills.

Boring and Turning Mills, 30, 37, 51 and 61 inch.



These machines built with double or single heads, or with one plain or one turret head. Latest improved design, powerfully geared and fitted with outer bearings for heavy service.

Send for Catalogue.

Baush Machine Tool Company,

Springfield, Mass., U. S. A.

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DESIGNS.

COMBINED WOOD TRIMMERS and MITERING MACHINES.

Made under the TYLER patents.

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Others pending.

Our arrangements for the **rapid** and **accurate** production of these High-grade, Labor-saving Machines have at last been completed.

We are now prepared to furnish these Handy Tools in large quantities and at prices which will surely please.

For ACCURACY, CONVENIENCE and UNIVERSALITY these machines are unexcelled.

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Through the generosity of the founders of the **American School of Correspondence**, and of several prominent manufacturers interested in the better Technical Education of Wage-Earners, the Trustees are able to award each year a limited number of

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(Chartered by the Commonwealth of Massachusetts,)

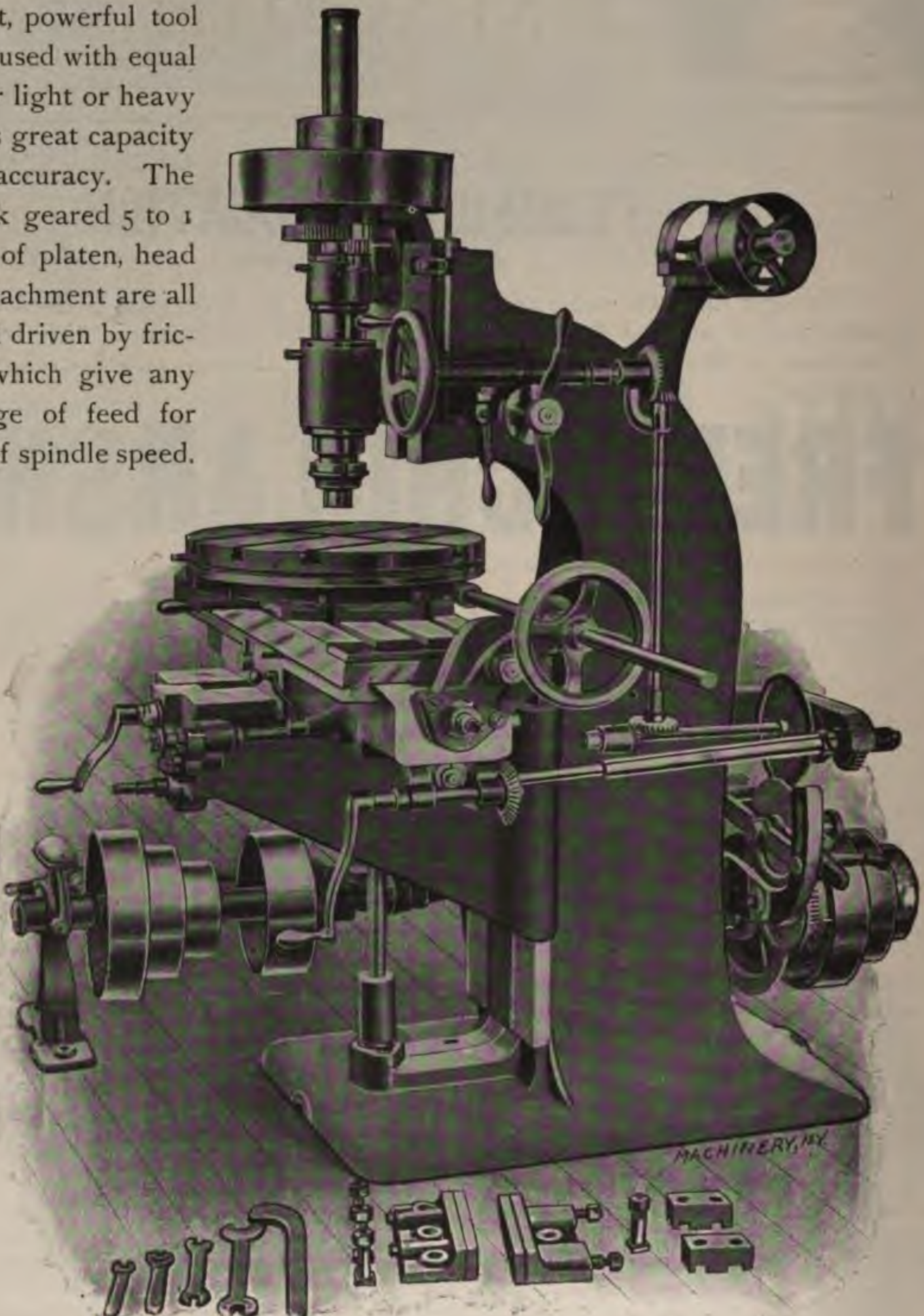
BOSTON, MASSACHUSETTS, U. S. A.

The Blake and Johnson

Vertical Milling Machine

Number Five

Is a well built, powerful tool which can be used with equal advantage for light or heavy work, and has great capacity as well as accuracy. The spindle is back geared 5 to 1 and the feeds of platen, head and rotary attachment are all automatic and driven by friction wheels, which give any desired change of feed for each change of spindle speed.



Send for catalogue showing our full line of Milling Machines.

Blake & Johnson,

127 East Main Street,
Waterbury, Conn., U. S. A.

Selling Agents, Manning, Maxwell & Moore.

The H. C. & Co.

Improved Sensitive Friction Drills

No. 1—With motor drive. Guaranteed capacity, $\frac{9}{16}$ in. and smaller—but can do better.

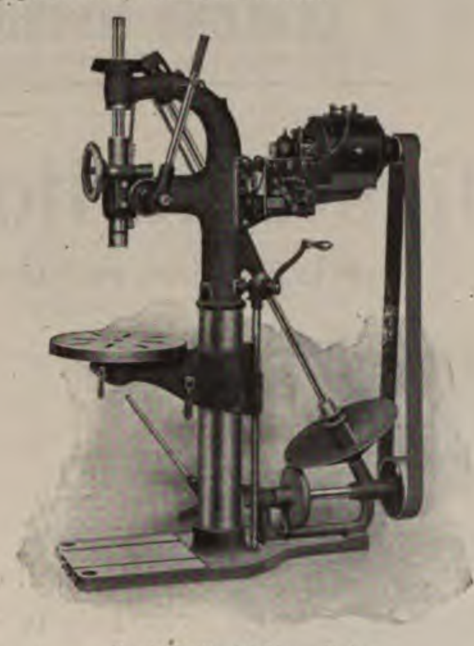
Thrust of spindle, and thrust of disc, both carried on ball bearings.

No. 2—Will drill $1\frac{1}{4}$ in hole in cast iron 1 inch deep in one minute, with wheel feed Also quick return.

Table is adjustable on column and instantly clamped in any position by attached wrench.

No 3—24 inch size; automatic feed and adjustable head; back geared; will drill $2\frac{1}{2}$ in. or smaller.

The most perfect type. No waste of power. Speed varied by foot treadle (leaving hands free) while the work goes on. No stopping necessary.



No. 2—Drill with Motor Drive.

Most powerful when speed is slow; most sensitive when high; instantly responsive. With belt or motor power. Friction disc is always dry. No wasting or sprinkling of oil, common to other types of friction drills.

Write for circulars and prices.

Hill, Clarke & Company

Better-best machine tools

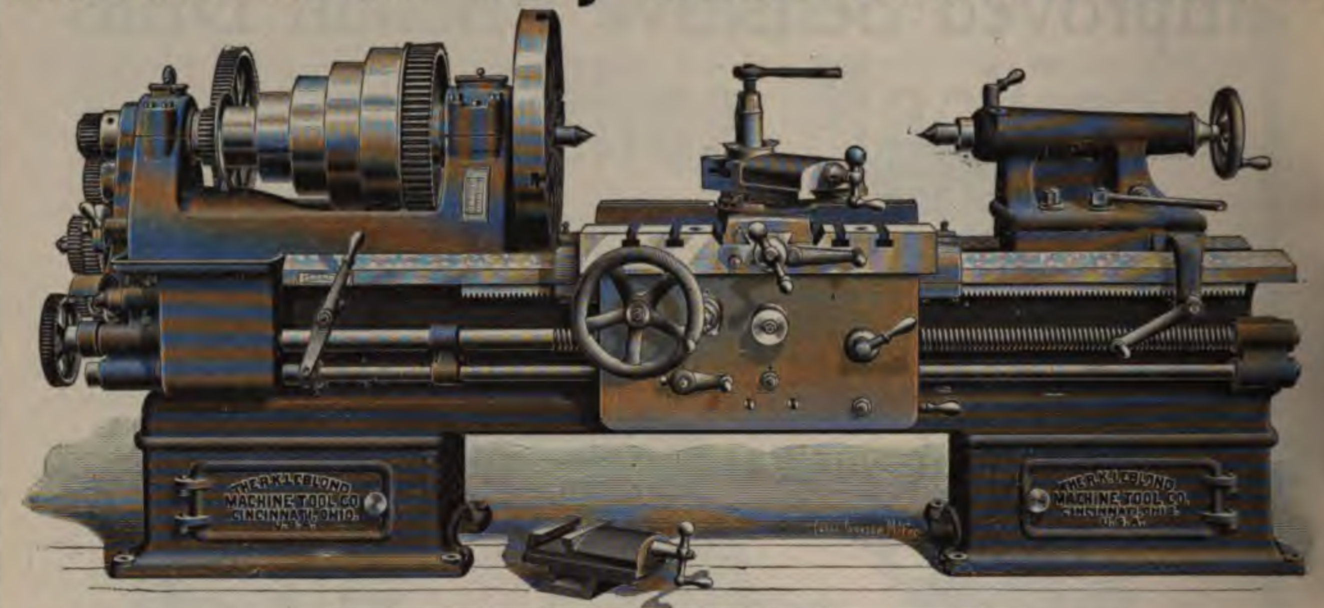
BOSTON: at 156 Oliver street.
CHICAGO: at 14 south Canal street, with a model demonstration machine shop in the basement.
NEW YORK: at 253 Broadway.

CHAS. CHURCHILL & CO., Ltd , selling agents for England and Scotland at London, Birmingham, Newcastle-on-Tyne and Glasgow.

On exhibition in the Philadelphia Bourse, at the stand of W. E. Shipley.

"SHOP TALK" a magazine for machinery buyers and users; published monthly at the Chicago store: 50 cents a year

This Lathe Makes All Others Go Way Back and Sit Down.



NEW! The LeBlond 27 and 30 inch Engine Lathes have three independent feeds on the feed rod which can be changed instantly by lever shown in front of head, and are so arranged that by change-gears the range can be made to suit any work, the three feeds increasing in geometric progression from the feed selected by the operator. It has a practical, everyday money-making value that isn't easy to compute or to estimate. Of course, we get an independent feed through change-gears, securing any feed from .005 to .100 to one revolution of the spindle. There are other LeBlond Lathe features that you ought to know about, and we'll be glad to tell you what they are if you'll let us know you're interested.

THE R. K. LEBLOND MACHINE TOOL CO., Cincinnati, Ohio, U. S. A.

The Niles Tool Works Co., Eastern Agents. 4605-4619 EASTERN AVENUE.

Adjustable Hollow Milling Tools

Made in four sizes, each size having an adjustment of one-half inch.

Can be adjusted to mill from the smallest to the largest diameter without the use of an extra set of blades, and in far less time than it takes to adjust any other style of hollow mill on the market, as there are **only two pieces to be operated** in making the adjustment.

These tools can also be used for thread cutting and much special work such as counter-boring, facing, pointing, cutting tapers and to take two cuts at the same time.

Write for No. 6 Tool Catalogue.

The John M. Rogers, Boat, Gauge and Drill Works,

Gloucester City, N. J., U. S. A.

THE G. A. GRAY CO.

Manufacturers of Planing Machines...

Cincinnati, Ohio, U. S. A.

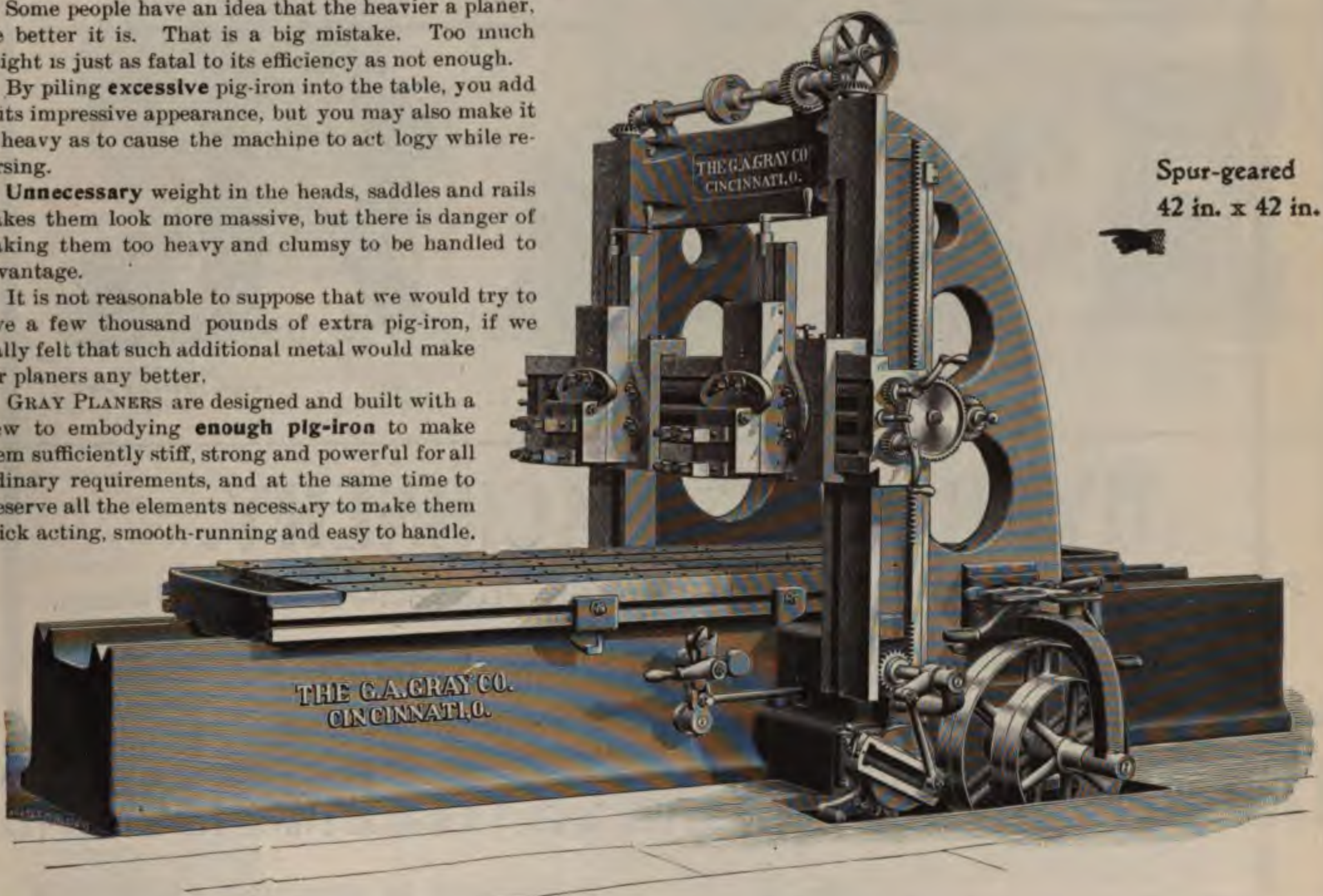
Some people have an idea that the heavier a planer, the better it is. That is a big mistake. Too much weight is just as fatal to its efficiency as not enough.

By piling **excessive** pig-iron into the table, you add to its impressive appearance, but you may also make it so heavy as to cause the machine to act logy while reversing.

Unnecessary weight in the heads, saddles and rails makes them look more massive, but there is danger of making them too heavy and clumsy to be handled to advantage.

It is not reasonable to suppose that we would try to save a few thousand pounds of extra pig-iron, if we really felt that such additional metal would make our planers any better.

GRAY PLANERS are designed and built with a view to embodying **enough pig-iron** to make them sufficiently stiff, strong and powerful for all ordinary requirements, and at the same time to preserve all the elements necessary to make them quick acting, smooth-running and easy to handle.



Spur-geared
42 in. x 42 in.

CARNEGIE STEEL CO., MUNHALL, PA.

November 12, 1901.

CLING-SURFACE MFG. CO.,

Gentlemen — I give below our experience with Cling-Surface. In June, 1900, we had the 12 in. belts on 7-80 Brush arc machines stretched as far as tightening slide would allow, at which point belts would have to be shortened.

We were using a belt dressing at that time, but still had to carry our belts so tight as to run risk of hot bearings. We then began experimenting with several kinds of dressing, of which Cling-Surface, giving best results, was adopted. We are now running the same belts, which have not yet been shortened, slacked up so that they sag to within about 8 in. of tight side when loaded, giving maximum wrap on pulley and minimum side pull on bearings.

We are well satisfied with results obtained and feel free to recommend Cling-Surface to all belt users. S. S. WALES,
Supt. Electric Department.

What Better Proof?

A large conservative company.
Competitive preliminary tests made.
Cling-Surface chosen as best.
18 months' use and a photograph of the belts.
Our guarantee that unless Cling-Surface is satisfactory after trial there is to be no charge—you return package at our expense.
Find out about this. Try it—at our risk.

Cling-Surface Mfg. Co.
153-159 VIRGINIA ST., BUFFALO, N. Y.
Branches in Principal Cities.

Results are what you want from your **EMERY WHEELS.** Write us for prices and samples. HAMPDEN CORUNDUM WHEEL COMPANY, SPRINGFIELD, MASS.

The Watson-Stillman Company,

204-210 East Forty-Third Street,

New York, U. S. A.

Heavy Hydraulic Die Press. Sheet 143.

Universal Hydraulic Beam Punch. Sheet 99.

Two Plunger Belt Pump. Automatic Variable. Sheet 279.

"Claw" Type Hydraulic Jacks. Sheet 11.

Independent Pump Hydraulic Jack. Sheet 127.

HYDRAULIC MACHINERY.

Presses, Pumps, Punches, Shears, Valves, Benders, Accumulators, Gauges, Fittings.

Hydraulic Jacks of every description. Tube Expanders.

THE WHITON REVOLVING CENTERING MACHINE

is designed to accurately center previously finished shafts four inches in diameter and smaller.

The work is held in two centering chucks, one of which revolves and acts as a driver. The shaft is firmly gripped in the revolving chuck, while the end near the tool is supported and revolved in the jaws of the stationary chuck as in a lathe center rest. The centers may then be drilled and reamed to the required depth by the drilling and reaming tools which revolve in a direction opposite to the work and at different speeds. It is only in this manner that finished shafting can be centered to run perfectly true.

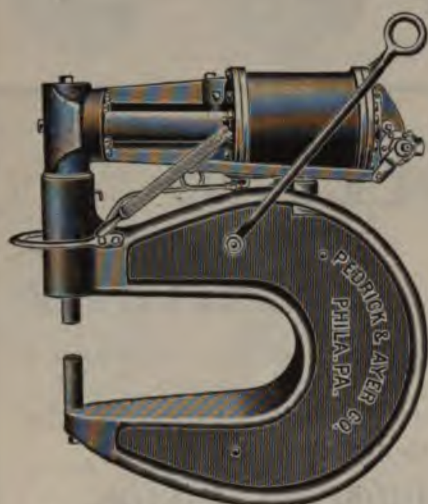
This new machine has all the advantages of our regular machines and the revolving attachment in addition. It has the same spindle mechanism, headstock and three-jaw centering chuck used in our Two-Spindle Centering Machine. Traverse of the spindles is limited by suitable stops; positive locking device for head prevents either spindle being advanced except when on centre, and when advanced no lateral movement of the head can occur.

SEND FOR CIRCULAR AND PRICE LIST.

D. E. WHITON MACHINE COMPANY, New London, Conn., U. S. A.

Air Compressors, Compressed Air Riveters, Hoists, Cranes and Other Tools

For Shop, Yard and Foundry Uses.



Portable Pneumatic Riveter.

Our New Line of Portable Pneumatic Riveters

comprises several styles and sizes and is adapted for any kind of work. These Riveters secure the maximum pressure on a rivet with as little weight in the machine as is possible. They work rapidly, without a jar or shock and give a uniform pressure upon the rivet.

SPECIAL SIZES BUILT TO ORDER.

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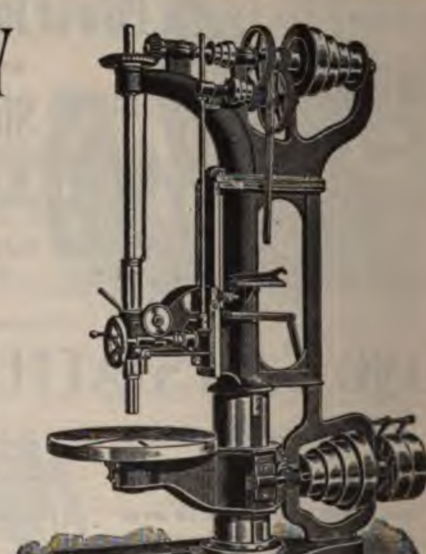
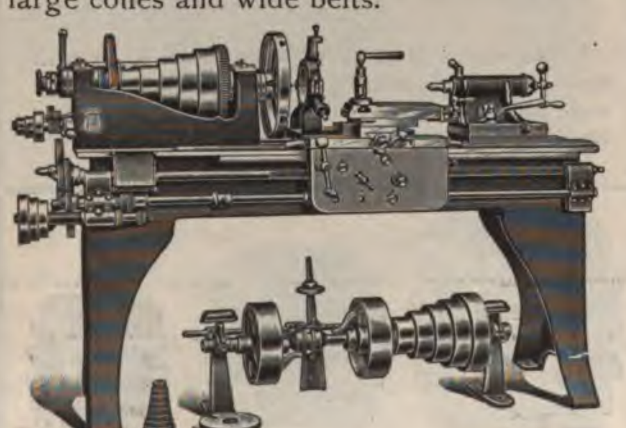
TOOLS THAT PAY THEIR WAY

are the kind you need and the kind we make.

We have had thirty-five years' experience in building Lathes and Drills and guarantee our tools in every respect. They are accurate, durable, simple in construction and in **quantity** and **quality** of work produced will equal any tool on the market. We build good all around Lathes and Drills for everyday purposes and special heavy Engine Lathes for special work. Our Lathes have six changes of belt feed; gear feed, screw feed. Built with plain, compound, raise and fall or English compound rest. Heavy, powerfully geared, large cones and wide belts.





All tools carefully tested before leaving the works.

Lathes, 13 inch to 36 inch swing.
Drills, 20 inch to 50 inch.

Pattern Makers' Lathes a Specialty.

Catalogue of full line mailed on request.

P. BLAISDELL & CO., 26 Jackson St., Worcester, Mass., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, Eng. Henry W. Peabody & Co., France and Australia. V. Lowener, Copenhagen, Denmark. Wilh. Sonneson & Co, Malmo., Sweden. Deutsche Garvin Maschinen Fabrik, Burg Strasse 17, Berlin, Germany.

ANYTHING YOU NEED

No. 3

SHEET METAL STRAIGHTENER AND CUTTER.

IN WIRE AND METAL WORKING MACHINERY

For flattening and cutting strip stock directly from the coil into lengths of 10 feet and under, and of a cross section of an area not exceeding 1-8 inch thickness by 14 inches wide, straightening and cutting about 150 feet per minute. The machines are built in two sizes smaller, and of any required length.
Write for illustrated catalogue.

THE F. B. SHUSTER CO.,
NEW HAVEN, CONN., U.S.A.

TRADE PAPER ADV. AGENCY, N.Y. 203

THE CHISHOLM & MOORE MFG. CO.

"MOORE" ANTI-FRICTION CHAIN HOIST.

FIG. 112. GEARED TROLLEY.

FIG. 113. PLAIN TROLLEY.

"DIRECT" DIFFERENTIAL PULLEY BLOCK.

Geared and Plain Yoke Trolleys.
Forged Frame, Steel Roller Bushed.

Adjustable to any size I Beam.

NINE SIZES, ONE TON TO TEN TONS CAPACITY.

The "Moore" Anti-Friction Chain Hoists.
Powerful, Durable, Easy Working. Eleven sizes, 1-2 ton to 15 tons capacity.

"Direct" Differential Pulley Blocks.
Six sizes, 1-4 ton to 3 tons capacity.

CLEVELAND, OHIO.

The Bard Adjustable Bushing. For Hand Die Stocks.

The Bushing is made to fit any die stock in place of the common ring bushing. Adjustable to all sizes of pipe and bolts. The adjustable bushing always guides the pipe perfectly to the center and insures a straight thread.

May always be left in stock.

Put a BARD ADJUSTABLE BUSHING on every stock you use, and save time and money.

MANUFACTURED BY

The Armstrong Mfg. Co.

New York Office, 139 Centre Street. BRIDGEPORT, CONN.

GAY & WARD, ATHOL, MASS., U. S. A.

Want to know if you use

Milling Cutters?

If so, we would like to do some business with you. Look over the following list of cutters we make which have these points of excellence:

Accuracy, Durability, Finest Workmanship,

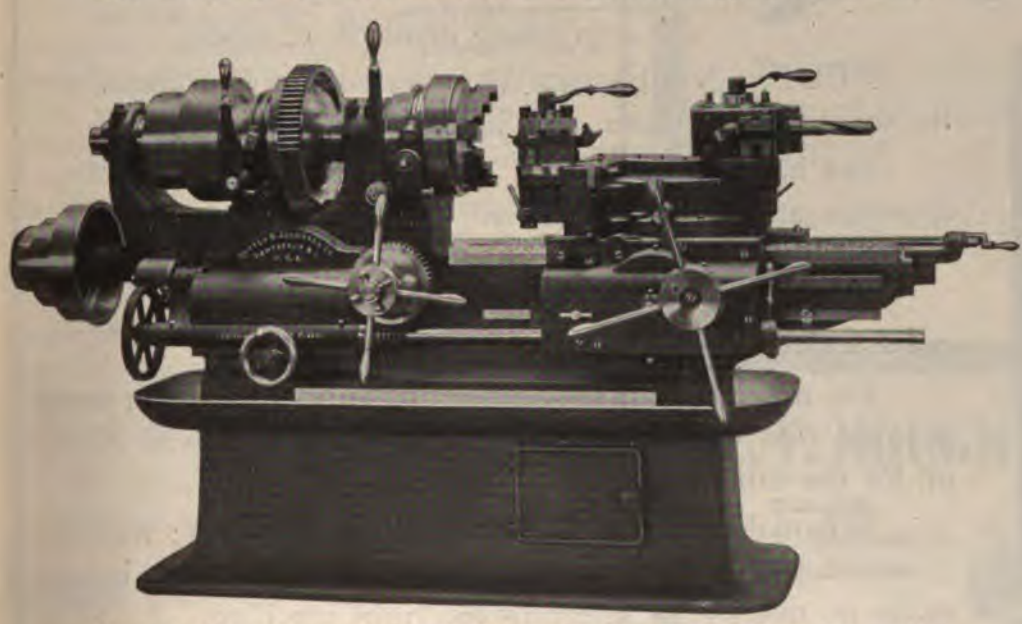
and if interested, send for our catalogue and prices, or better still send us a trial order. We will use you right. We manufacture:

Cutters for Cutting Gear Wheels, Twist Drills, Taps, Reamers. Irregular Formed Cutters which can be sharpened by grinding without changing the form. Milling and Side Milling Cutters with Plain or Inserted Teeth. Angular Cutters, Concave and Convex Cutters, T Slot Cutters, Screw Slotting Cutters, Metal Slitting Saws, End Mills.

The old saying can apply to this list—"If you don't see what you want, ask for it." We can make you anything in the cutter line.

It will pay you to investigate the merits of our **Double Turret Manufacturing Lathe.**

It possesses a number of new features; our Patented Lever Chuck, which was **AWARDED GOLD MEDAL AT THE PAN-AMERICAN EXPOSITION,** and is sold in connection with the machine, enables you to place your work into the chuck and remove the same without stopping the machine.



DOUBLE TURRET MANUFACTURING LATHE—Turning Turret shown in position.

Better let us send you full particulars.

Universal Shaping Machines

with all the latest up-to-date attachments, including swivel table, tilting side, power down feed and automatic feed stop.

Automatic Boring and Turning Machines,

Potter & Johnston Machine Co., NEW YORK OFFICE, 126 LIBERTY ST., WALTER H. FOSTER, MANAGER. **Pawtucket, R. I.**

FOREIGN AGENTS: Chas. Churchill & Co., London, Birmingham and Manchester, England, and Glasgow, Scotland. Adolphe Janssens, Paris, France, and Brussels, Belgium. V. Lowener, Copenhagen, Denmark, and Stockholm, Sweden.

We can refer you to more than 100 very prominent American Manufacturers of Machinery, Automobiles, etc., who will advise you to adopt THE WOODRUFF PATENT SYSTEM OF KEYING.

Thousands of milling operations are being made on expensive machines that could be done quicker and to better advantage on one of our Hand (Feed) Millers costing half the money.

HAND (FEED) MILLING MACHINES

a great specialty

LATEST "WHITNEY" 20-inch WATER TOOL GRINDER

Quality, Finish and Special Features of Advantage. Highest class. Price nearly as low as charged for the poorest machine on the market.

The Whitney Mfg. Company,

Hartford, Conn., U. S. A.

FOREIGN AGENTS: Fenwick Freres & Co. C. W. Burton, Griffiths & Co.

Style C. T. A.

THE AMERICAN DRILL GRINDER

is the Latest Improved and Best machine for grinding drills of all kinds.

BEST:—Not because WE say so, but Best because the men who use them, and actually know, say so.

We have more special features to make it handy, accurate and durable than all the other machines put together.

When you get a drill ground in this machine it will cut and cut fast.

Do not buy a poorly made machine when you can get one that wins in every competitive trial it was ever in, for the same money.

We make all styles both WET and DRY, and if you will give the machine a trial you will find you have made no mistake in selecting the right machine.

L. S. HEALD & SON, 222 M STREET, BARRE, MASS.

British Agents, Chas. Churchill & Co., London, England.

Stewart Gas Blast Furnaces

Steel Often Cracks

in heating and the manufacturer is blamed when the real fault lies in the variation of temperature in the furnace. **Stewart Gas Blast Furnaces** ensure not only an absolutely uniform temperature, but produce results in less than half the time by other methods and at a much smaller cost. You need only try one of our Furnaces to find out for yourself that these statements are true in every essential.

If you are heating your metals by the old method or if you are having your work done for you, write us for prices and estimates of the saving which we guarantee can be effected. This will cost you nothing.

We shall also be glad to mail on request copies of our new catalogue....

Chicago Flexible Shaft Company,

La Salle Avenue and Ontario Street, Chicago, Ill.

FOREIGN AGENCIES: Niles Tool Works, 23-35 Victoria Street., S. W. London. Fenwick Freres, 21 Rue Martel, Paris. Gustav Diechmann & Sohn 22 Neue Promenade Berlin

THE BEST CUTTING OILS

are those made especially for cutting purposes.

Nothing strange about that. Your cylinder oil is made especially for cylinder lubrication; your engine oil for lubricating your engine; then why not use cutting oils that are made for cutting?

Giant Screw Cutting Oil.
For general shop use.

Turret Lathe and Drilling Oil.
For turret lathes.

Automatic Machine Screw Oil.
For automatic screw machines.

General pipe, bolt and drilling oils.

All made with a scientific consideration of the work they are to perform.

Send for a CUTTING OIL pamphlet.

E. F. HOUGHTON & CO.

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W. Somerset St.,
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THERE ARE REASONS WHY

YOU SHOULD SEND FOR THE LATEST ILLUSTRATED CATALOG OF THE

NORTON EMERY WHEEL COMPANY.

TRADE MARK NORTON REGISTERED

164 Pages of Most Valuable Information and Suggestions.

It informs you of

Norton Emery and Corundum Wheels.
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Water Tool Grinders. Surface Grinding. Countershafts.
Norton Plain Grinding Machine for Cylindrical Grinding.
Grinding Attachment for Engine Lathes.
Bath Machine Indicator.

You are most cordially invited to call at our works. A visit will prove instructive and demonstrate to you why it is that

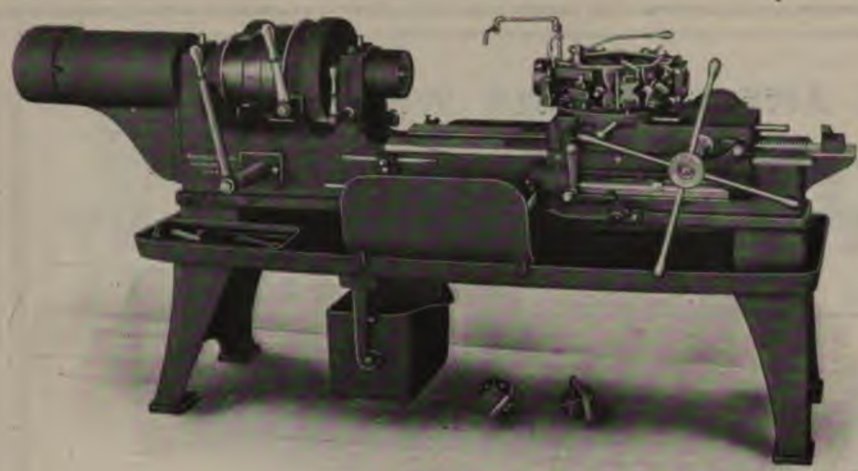
NORTON PRODUCTS ARE THE STANDARD.

Our floor space, 136,714 square feet—is now equal to a room 26 feet wide and a mile long.

NORTON EMERY WHEEL COMPANY,

OFFICE AND WORKS AT WORCESTER, MASS.

CHICAGO STORE—25 S. CANAL ST. AGENCIES—"ALL OVER THE WORLD."



ASK FOR "THE HOLLOW HEXAGON TURRET LATHE BOOK."

The Hollow Hexago Turret Lathe.

Capacity—bars up to 2 inches in diame can be fed through the automatic chuck turned any length up to 24 inches.

Complete set of tools for general work f nished with each machine.

Our complete line of Screw Machines, T ret Lathes and Brass Working Machinery fully illustrated and described in our Gene Catalog. We shall be pleased to send yo copy.

The Warner & Swasey C

Cleveland, Ohio, U. S. A.

EUROPEAN AGENTS: Chas. Churchill & Co., London, Birmingham, chester and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Brussels, holm and St. Petersburg. Adolphe Janssens, Paris.

New No. 2 1-2 Universal Milling Machine.

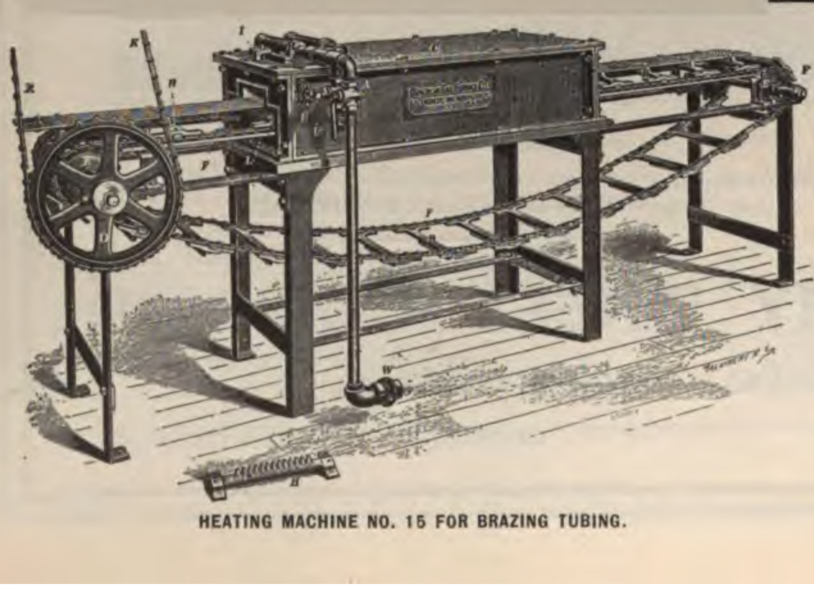
You—

are no doubt discouraged if you are using a universal miller with a belt feed that slips at the least strain, and every other part that weakens when under cut, wasting your time and spoiling your work. We can save you money and gray hairs, for we have been studying these faults for many years, and have spared no brains or labor in endeavoring to make our New No. 2½ Universal Milling Machine a model for the mechanical world to copy from.

We are now ready to do business, are you?

A postal card brings a booklet.

The Garvin Machine Co., Spring & Varick Sts., New York. 51 No. 7th St., Philadelphia, Pa.



HEATING MACHINE NO. 15 FOR BRAZING TUBING.

THE LIMIT

to the number of tubes which can be soldered si ultaneously on this machine is only governed by t speed with which they can be properly placed the moving racks, properly charged with sold **HEATING MACHINES** of this style are design for brazing tubing of any metal, size or kind seam up, and solder from the outside.

Send for circulars of this machine and ot styles manufactured by the

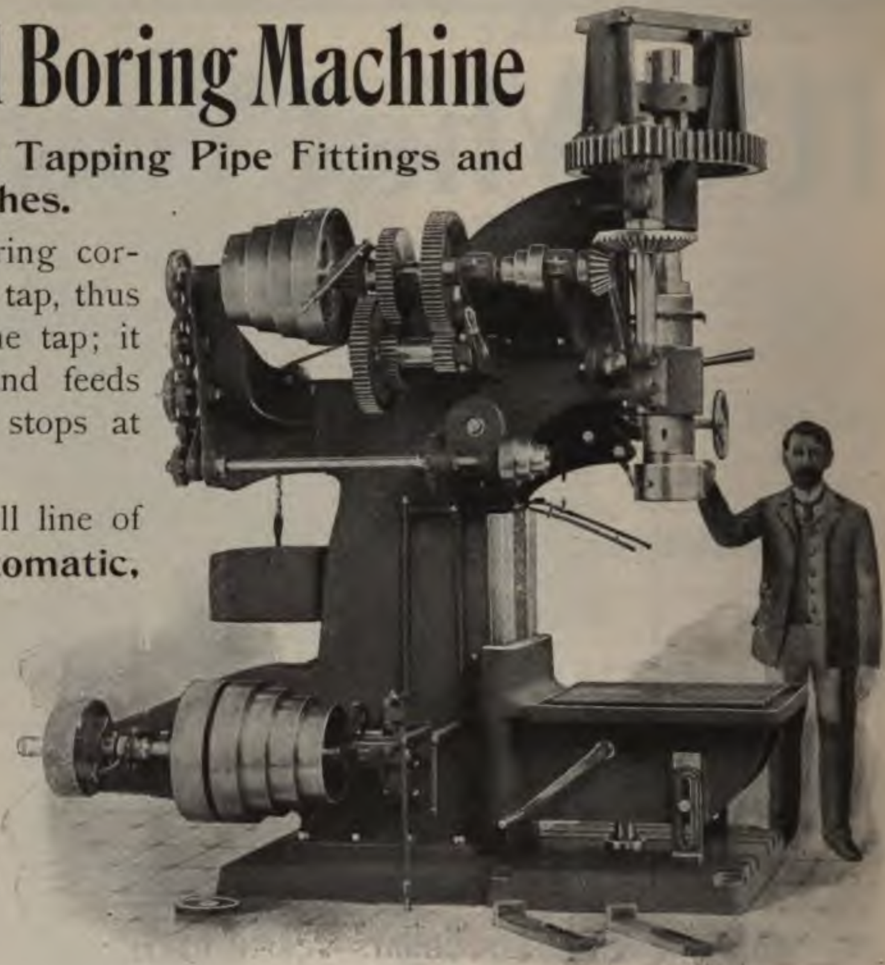
AMERICAN GAS FURNACE C

23 JOHN STREET, NEW YORK.

Chas. Churchill & Co., London, Birmingham, Manche and Glasgow. H. Glaenzer & Perreaud, Paris Schuch & Schutte, Berlin, Cologne, Vienna, St. Petersburg.

Tapping and Boring Machine

For Drilling and Tapping Pipe Fittings and Flanges up to 16 inches.



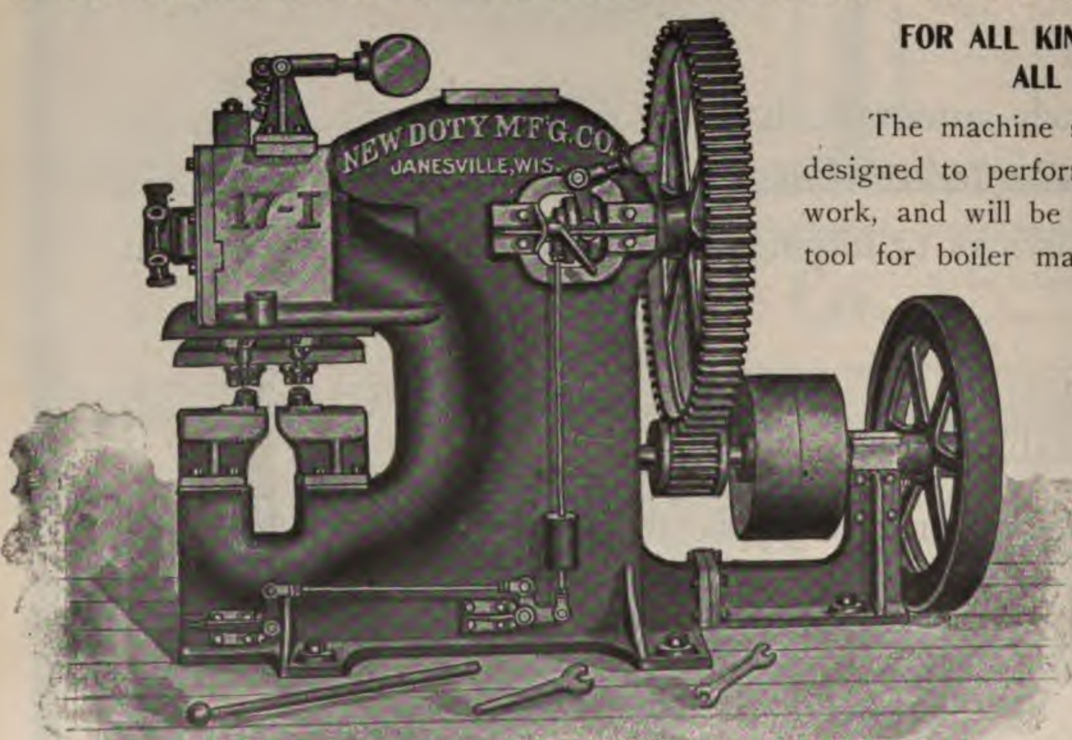
Tap is fed by gearing corresponding to the lead of tap, thus taking all strain off of the tap; it automatically reverses and feeds back, and automatically stops at any desired point.

We also build a full line of **Keyseaters, Full Automatic,** built in five sizes.

BAKER BROS.,
TOLEDO, OHIO,
U. S. A.

AGENTS: Marshall & Huschart, Chicago and Cleveland. U. Baird Mchy. Co., Pittsburg. Manning, Maxwell & Moore, New York. E. A. Kinsey, Cincinnati. J. W. Wright, St. Louis. Hill, Clarke & Co., Boston. Schuchardt & Schutte, Berlin, Brussels, Vienna. Chas. Churchill & Co., London.

PUNCHING AND SHEARING MACHINERY



FOR ALL KINDS OF WORK.
ALL SIZES.

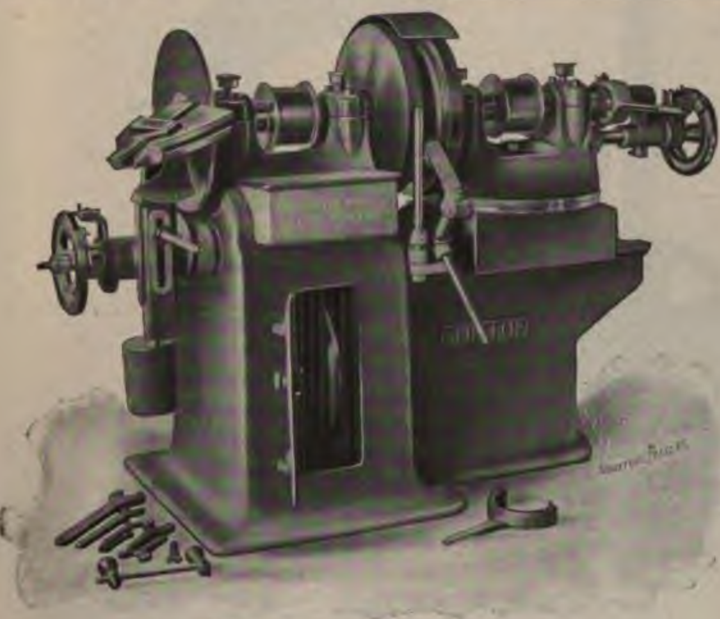
The machine shown in engraving is designed to perform a variety of heavy work, and will be found a very efficient tool for boiler makers and builders of iron ships and iron bridges.

Can be readily changed from a Punch to a Shear, and back again. Each machine furnished with one set of either punching or shearing tools.

Send for Catalogue D.

NEW DOTY MFG. COMPANY, 150 North Main Street, JANESVILLE, WISCONSIN.

USE A GORTON DISC GRINDER... FOR FLAT SURFACES



No. 15 Disc Universal Flat Surface Grinder.

Insures accuracy, and does the work in a fraction of the time it could be finished in any other way.

This cut shows a Cold Pressed Hexagon Nut. Short diameter 2 inches. Roughed and finished accurately in three minutes on our No. 6 Disc Universal Grinder. Time required by New No. 15 Machine, one and one-half minutes.

Brass Casting 4½ inches long. Finished from the rough on two Inside Slot Faces, on two Outside Slot Faces on the entire Flat or Face Side, and on Outside Edges extending around the hub. Roughed and finished accurately in ten minutes on No. 6 Machine.

Same work done on New Machine in five minutes.

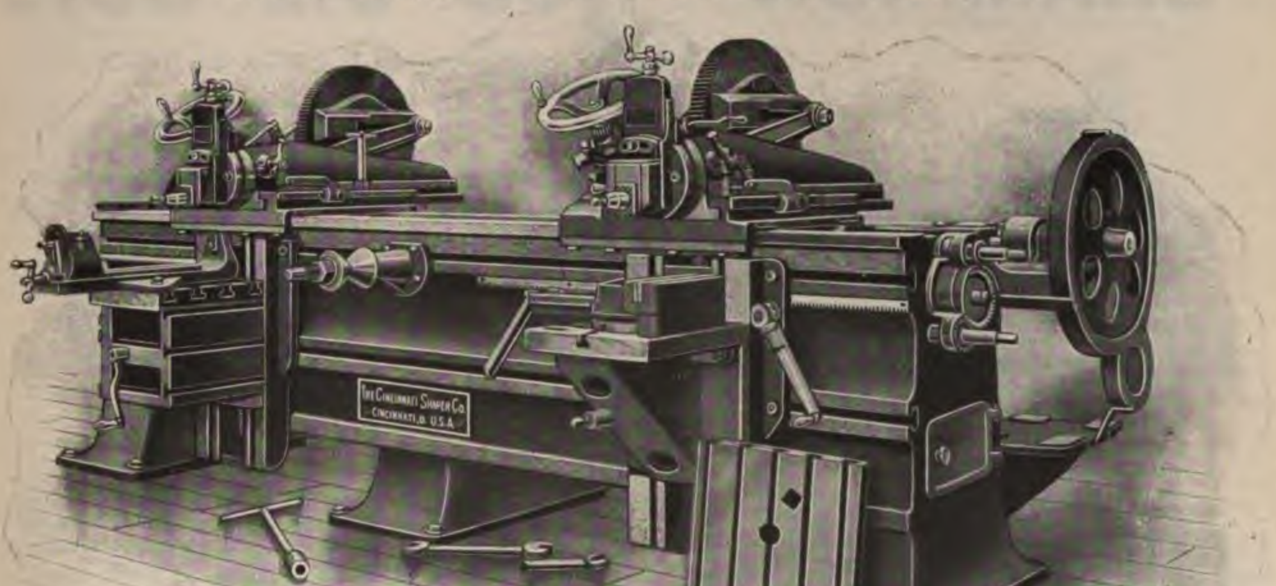
Eight inch Connecting Rod Key, O. H. Steel, finished all over. From 1-100 to 2-100 inch of stock removed on each face. Roughed and finished on No. 4 Disc Universal—time, fifteen minutes. Finished on New No. 15 Machine in about seven and one-half minutes.

Send us samples of your work requiring flat surfaces and we will finish and return them free of charge, giving time required for the work.

GEO. GORTON MACHINE CO., - RACINE, WIS., U. S. A.

Cincinnati Traverse Head Shapers

16, 18 and 20 Inch Single Geared Crank. 24 inch Back Geared Crank. 30 Inch Rack Driven.



Cut shows 18 in. x 12 ft. Double Head Traverse Shaper, arranged for Direct-geared Motor Drive.

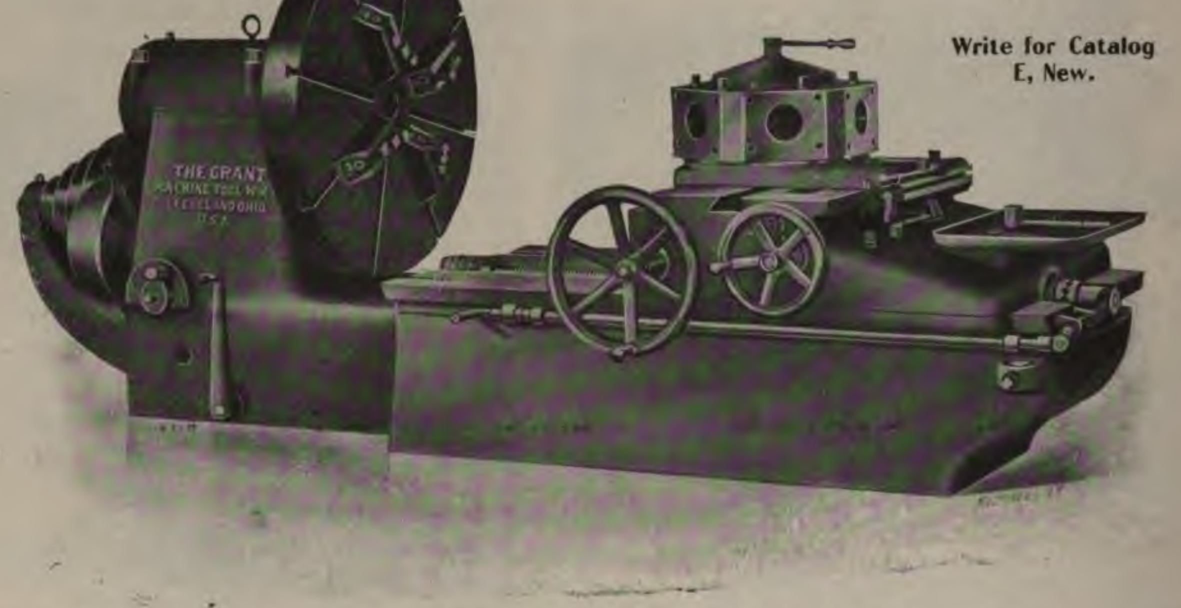
Our Traverse Head Shapers are of the most modern design, are the heaviest and most powerful of their class made, have long and wide bearings, with means for taking up wear, and are convenient to operate; means for actuating all feeds being located on the saddle. The Double Head Machines have each head independently driven and from separate screws; thus making it possible to operate the two heads close together, even at the extreme ends of the bed.

Your Inquiries Solicited. Visitors Welcome.

THE CINCINNATI SHAPER CO., 1403-1413 Sycamore St., CINCINNATI, O., U. S. A.

Our Turret and Chucking Lathes

Write for Catalog E, New.



Are powerful and rigid tools designed for light and heavy work. The base and head are cast in one piece and stiffened by internal cross girts.

The 44 inch size, shown in engraving, is a machine especially adapted for locomotive, stationary and marine engine and pump works, for turning, boring and facing pistons, piston rings, cylinder heads, etc

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"CHAMPION" ROD OIL CUP.

Suitable for all movable bearings, is simple and practical in construction and can be filled without detaching plug. Glass sides show stage of oil. Attach Cup so that the glass sides are parallel with the rod. When cup is in motion the oil begins to travel in a body within the cup, and at each revolution is thrown against the feed tube and flows down through it to the bearing. The centrifugal force, combined with the shape of the body, carries the oil to the holes in the feed tube. Made in four sizes, holding from 1¼ to 12 ounces of oil. A trial solicited and satisfaction guaranteed. Write for catalogue of superior brass and iron steam specialties. Specify "LUNKENHEIMER" make and order from your dealer.

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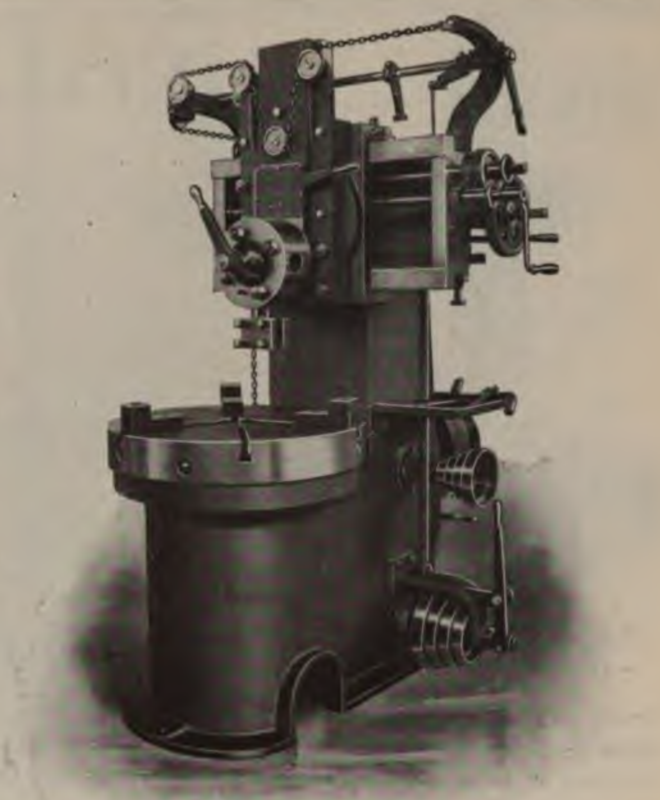

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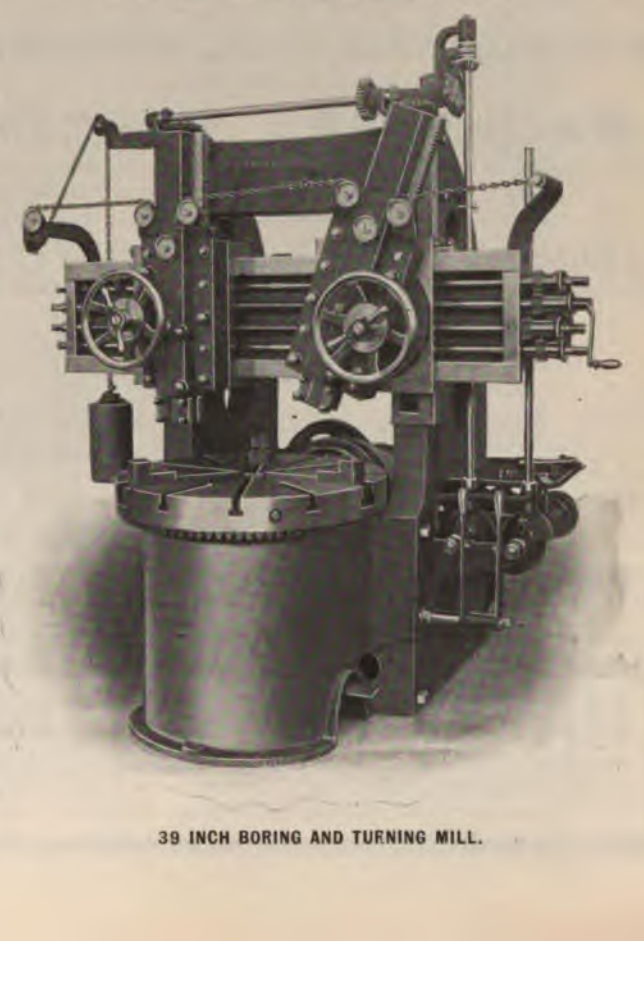

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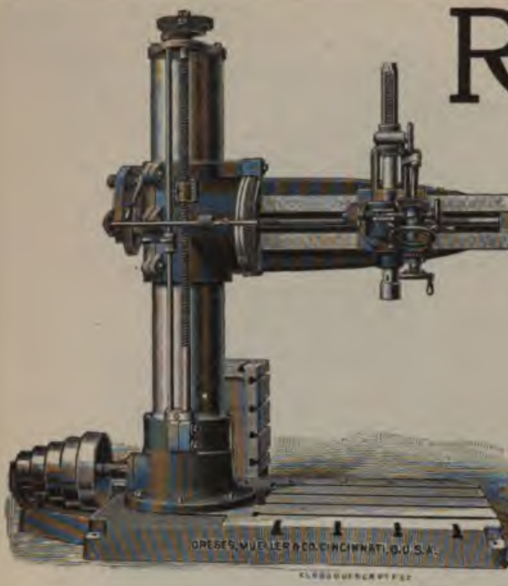

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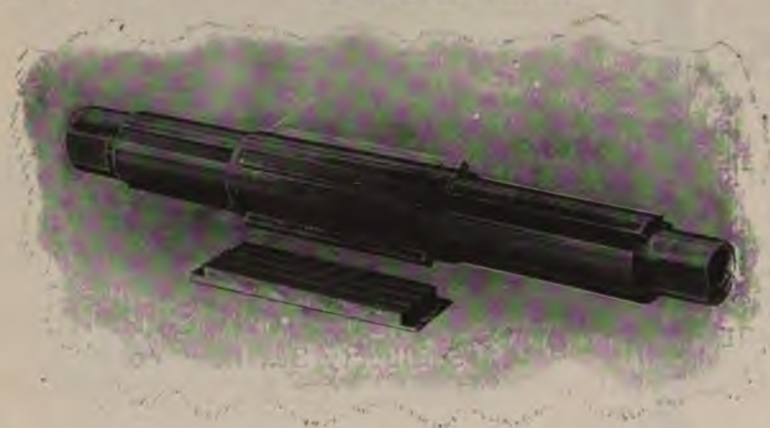

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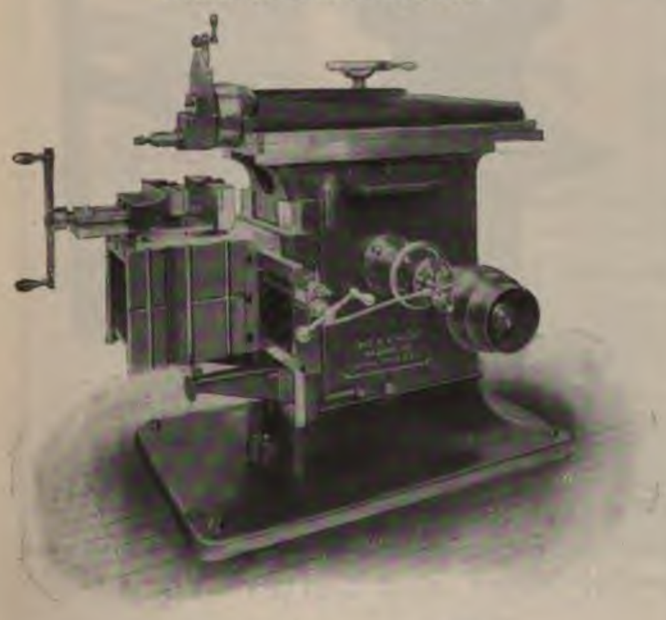

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TAKE NOTICE.—That this company never made any Buckeye or "Yankee" Drill Grinders against former makers of which patent suits are said to be pending. That we were never connected with such companies. That we never made use of the old time gage jaw construction involved in these suits.

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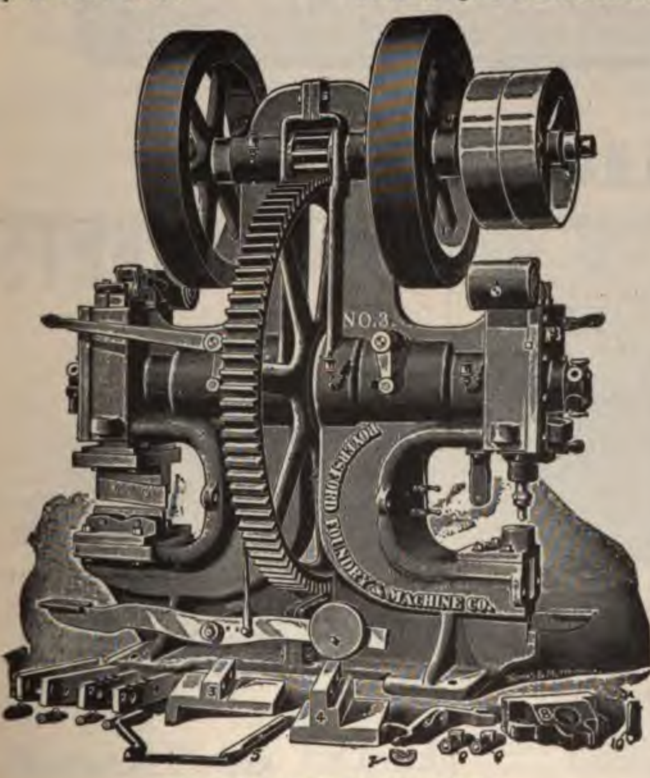

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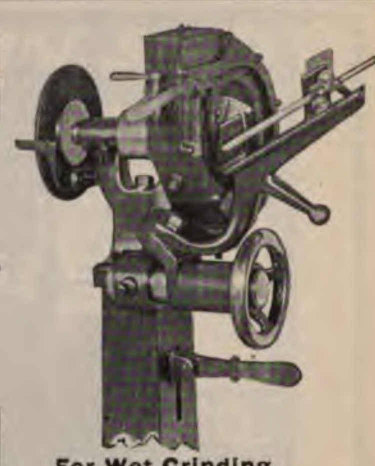

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Perform every operation simultaneously, finishing an entire piece in the time required for a single operation on other machines. Write for further details.

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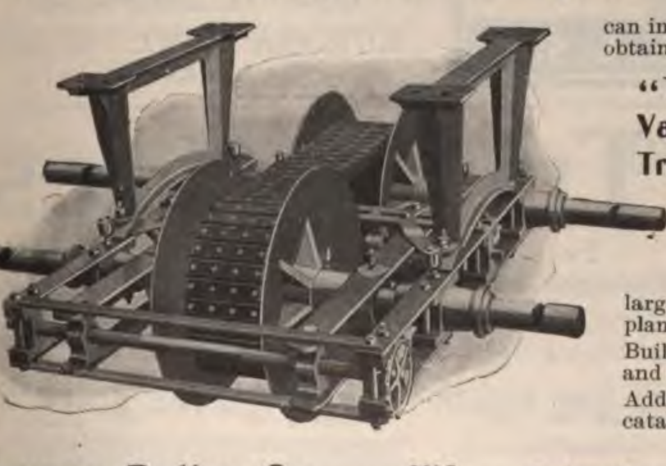

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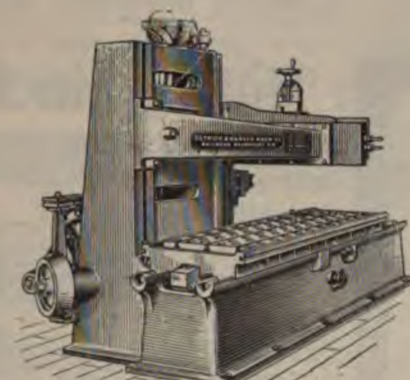

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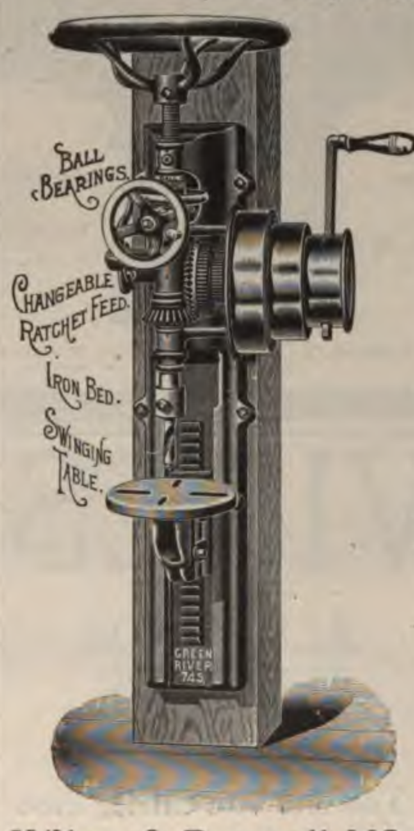

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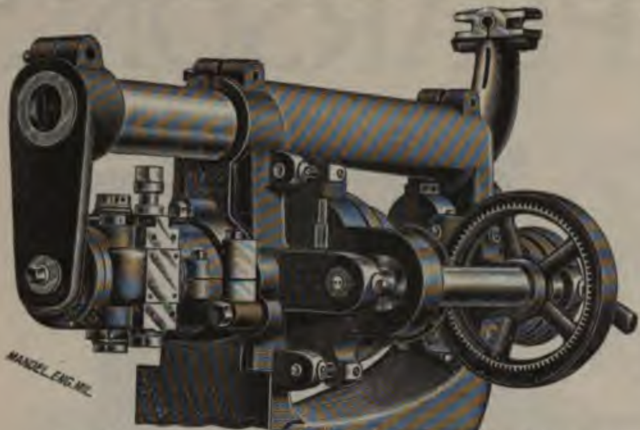

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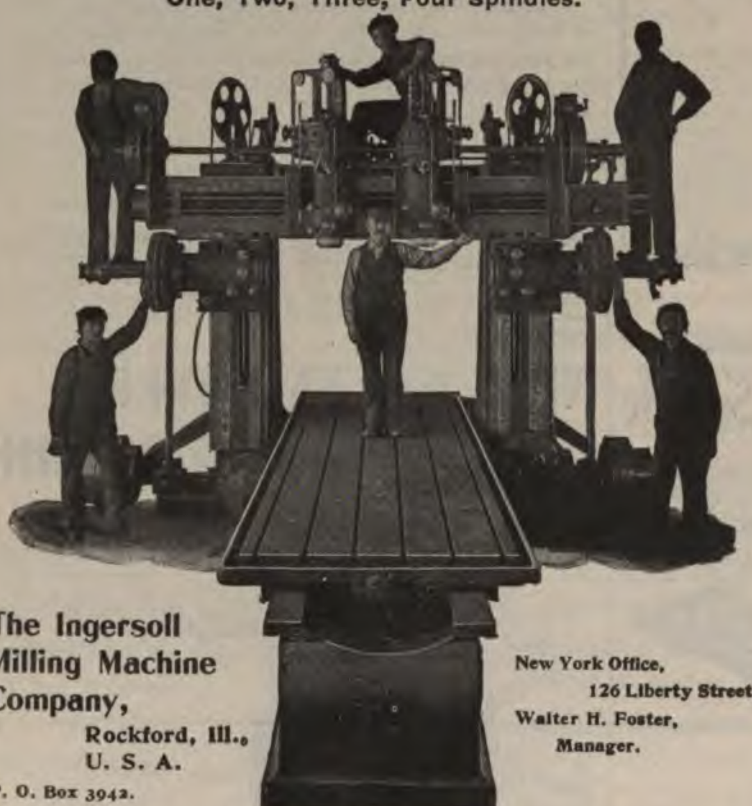

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Swivels from Horizontal to Vertical.

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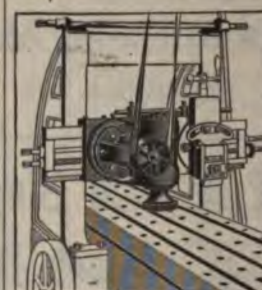

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It is strong, substantial, fitted with all the latest improvements and admirably adapted for turning out small or medium work with the greatest degree of accuracy and economy. Sizes 9 to 15 in. swing. Full descriptive catalogue.

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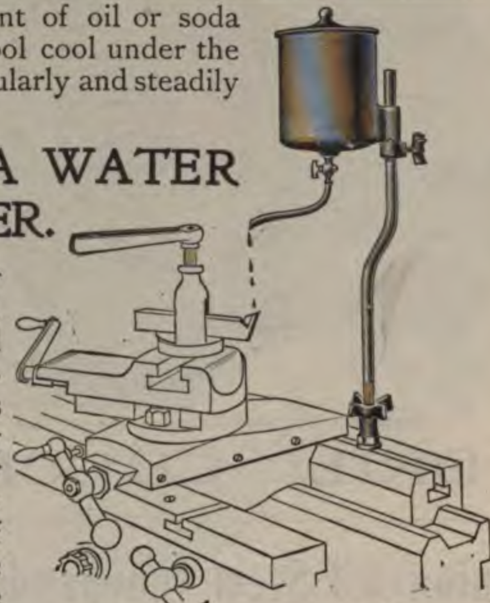

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STYLE A IN USE.

For Bit Braces. Chain Attachments and Screw Feed.

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Well finished, strongly made and moderate in price. Three styles, A, AA and B. Send for prices and full description.

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Patented April 30, 1895. and May 15, 1900.

Strong, Durable, Made of Steel.

Handle-frame and ferrule in one piece, rigidly keyed to the bar. Ferrule and cup-tip firmly secures and prevents wood sides from splitting. Improved method of case-hardening used. None genuine unless stamped Coes Wrench Co. Write for descriptive catalogue and 1901 price list.

All sizes of the Improved Wrench now ready.

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From 22 in. to 120 in. square, any length.

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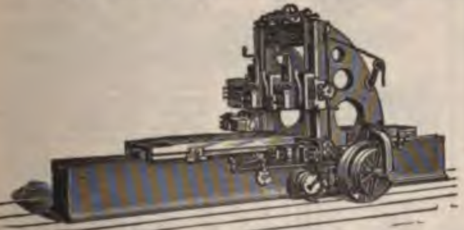

Have a Patent Dirt Proof Table which prevents chips from falling into the Vs. They have a Safety Locking Device which avoids accidents and spoiling of work. They have Micrometer Adjustment to the down feed, and a Patent Combination Friction that will not stick or burn out. Made in ten sizes, 24 in. to 56 in. square.

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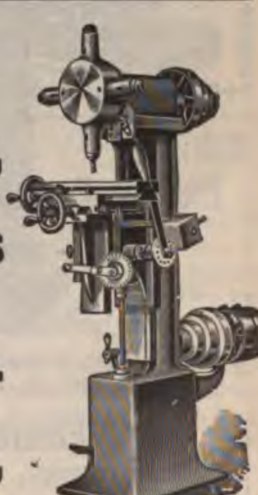

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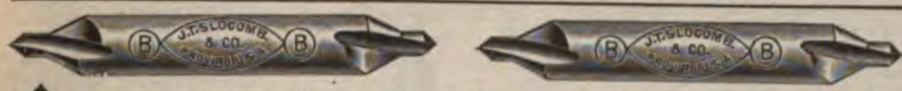

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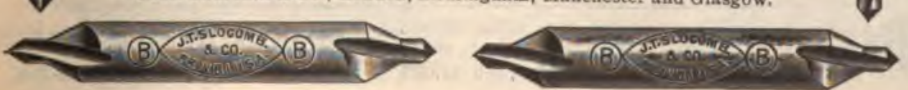

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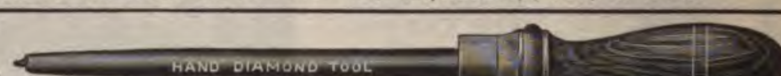

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